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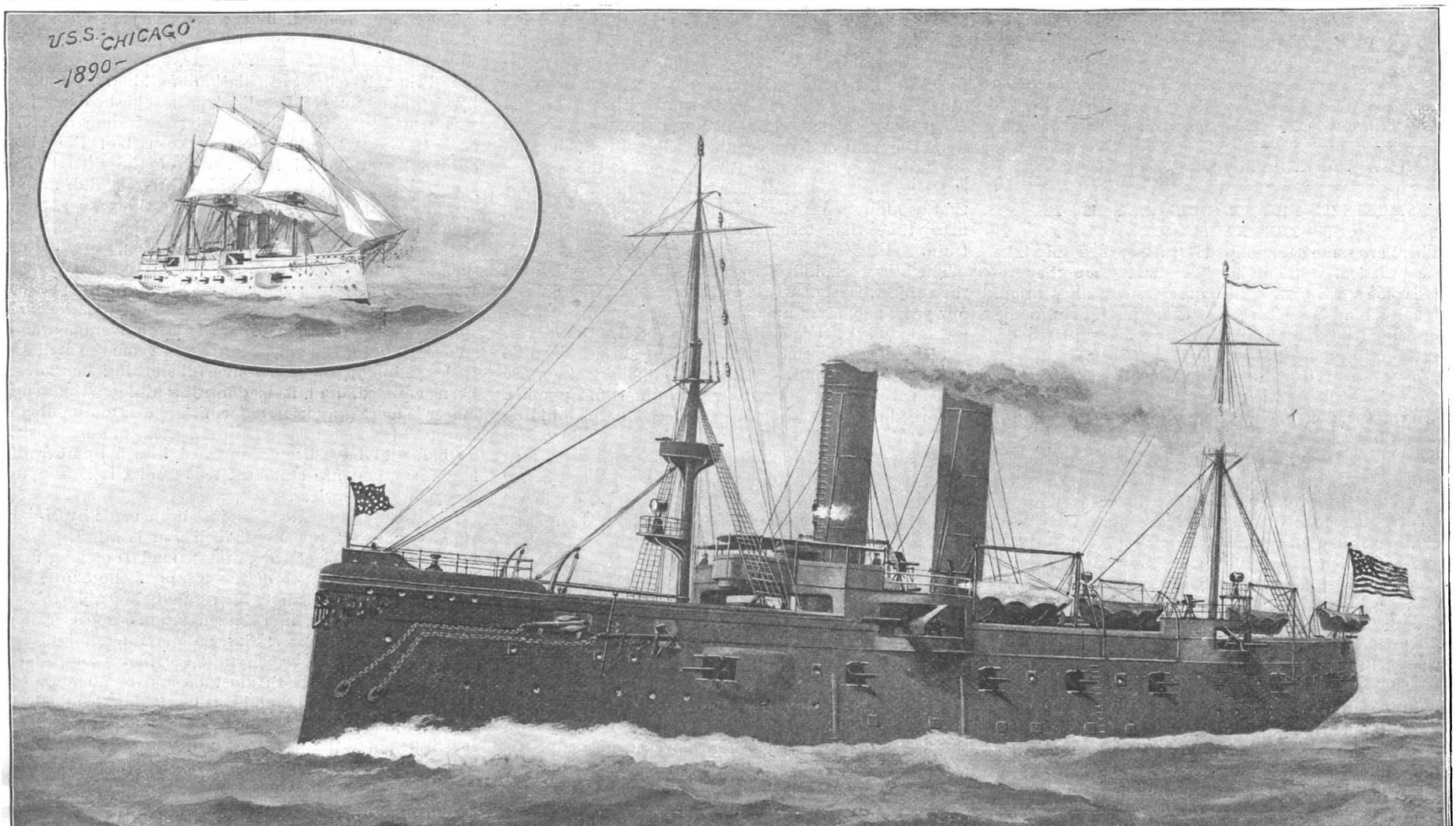
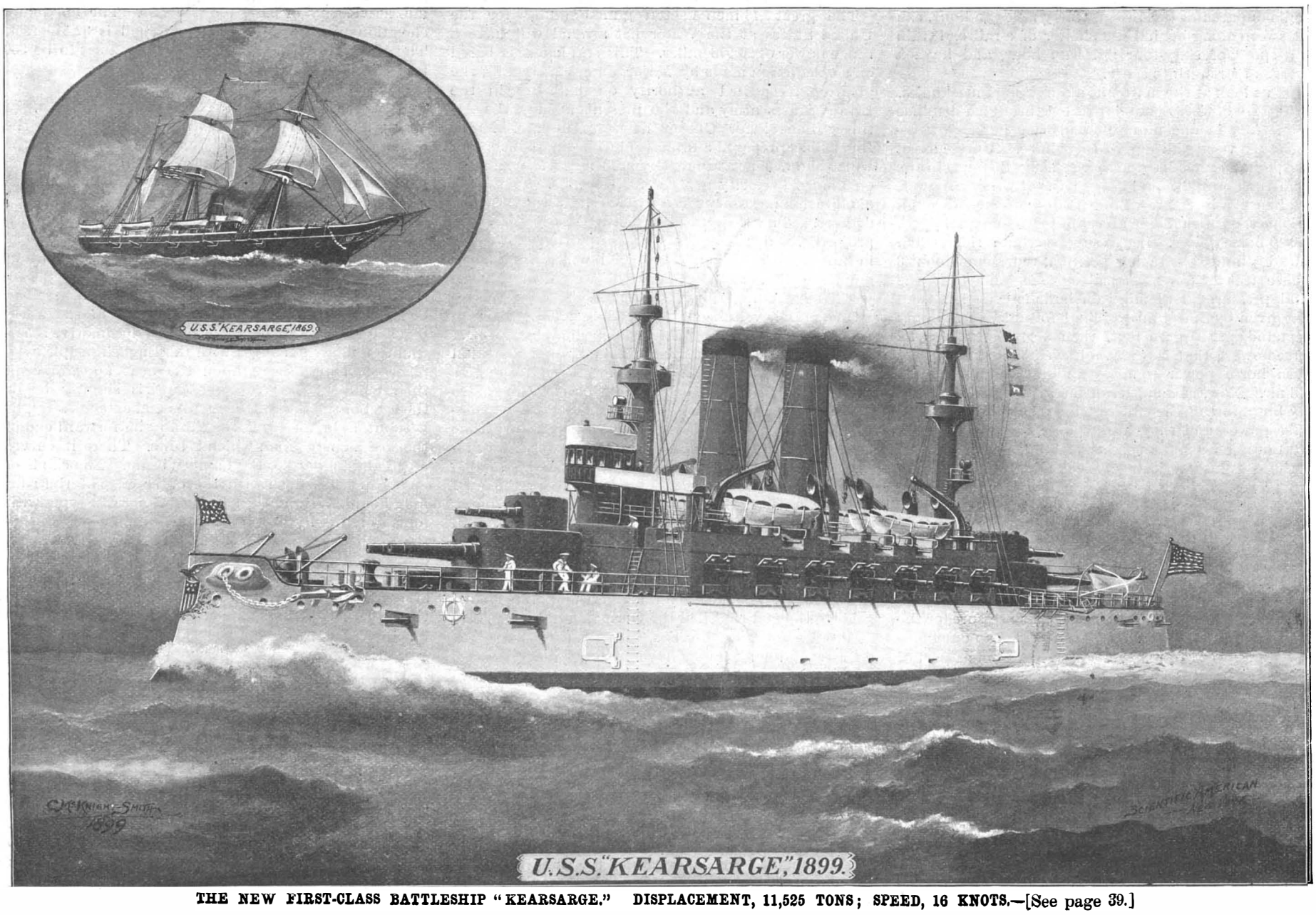


THE RECONSTRUCTED CRUISER "CHICAGO." DISPLACEMENT, 4,500 TONS; SPEED, 18 KNOTS.—[See page 39.]



THE NEW FIRST-CLASS BATTLESHIP "KEARSARGE." DISPLACEMENT, 11,525 TONS; SPEED, 16 KNOTS.—[See page 39.]

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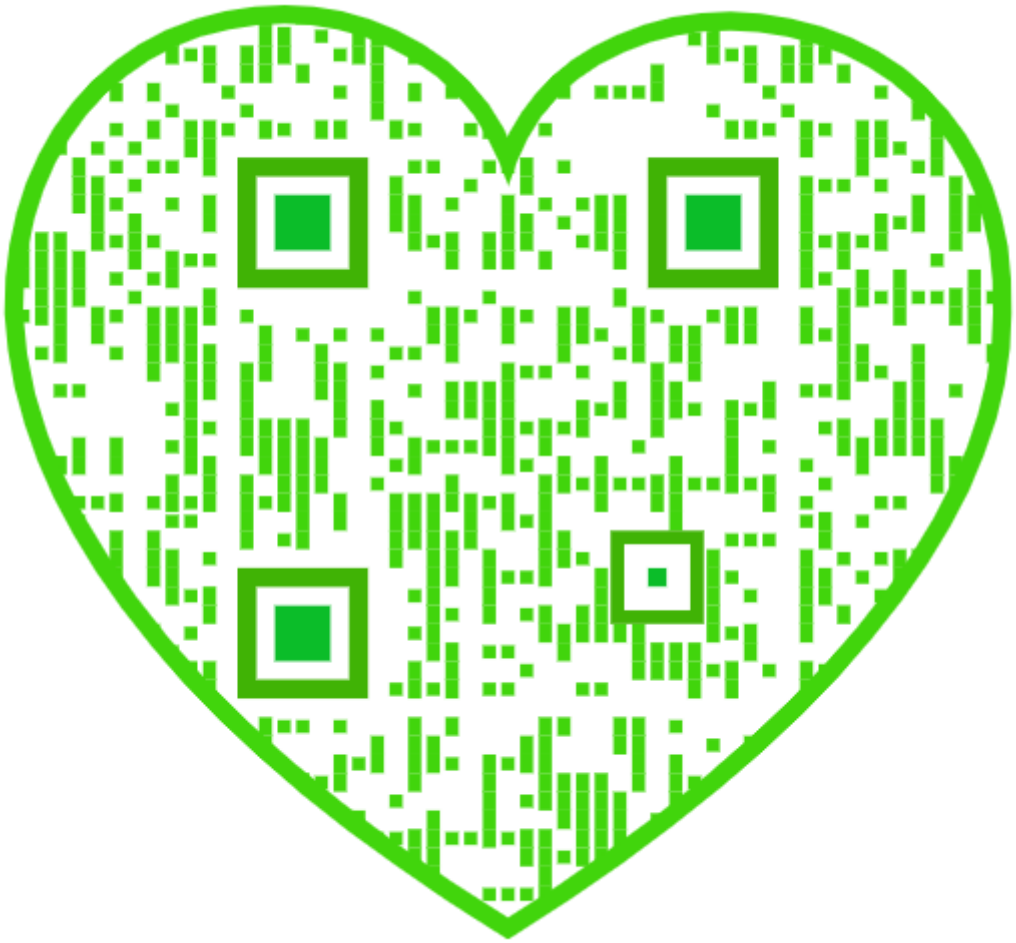

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NEW YORK, SATURDAY, JULY 15, 1899.

MURPHY'S BICYCLE RIDE A HINT TO THE RAILROADS.

There are some commonplace truths which only take on a practical value in men's minds when they receive some startling and easily understood illustration. Of such a kind is the theory of atmospheric resistance to moving bodies. People who are, or ought to be, greatly interested in the subject (foremost among whom are the railroad men of the country) are aware that air resistance is one of the impediments that keep down the speed of moving bodies; but we question if one in a hundred of them realizes that this is not merely one, but probably at high speeds the chief resistance. Engineers and architects are all familiar with the tables of wind pressure, from those of Smeaton to the later ones of Trautwine, Kent and others; and roofs, bridges and other frame structures are proportioned to meet pressures which range anywhere between 30 and 56 pounds to the square foot, according to the particular selection which is made from among the many tabulated guesses as to wind pressure which adorn the accepted technical pocket-books of the day. But while it is believed that a 60-mile wind will exert an 18-pound (Smeaton) or a 36-pound (Trautwine) pressure per square foot, it does not seem to occur to practical men that a 60-mile train (action and reaction being equal) will be subject to the same unit of pressure—or if it does occur to them, the fact is steadily ignored.

Elsewhere in this issue will be found a full account of the ride of a mile a minute recently made by a bicyclist behind the shelter of a locomotive and car. The facts are profoundly significant. Here is a man who, even if exerting himself to the utmost, could not ride a mile unpaced at the rate of thirty miles an hour, can yet sweep along behind the shelter of a railroad train at a speed of sixty-four miles an hour, and have a reserve of strength to spare.

Let us look at the matter as a question of mechanics. A pressure of 33,000 pounds exerted through a distance of one foot in one minute equals one horse power—at least so we are all agreed to believe. A pressure of one pound exerted through the same distance in the same time would equal $\frac{1}{33000}$ part of a horse power, and hence a pressure of one pound exerted through 5,280 feet, or one mile, in one minute would equal $\frac{5280}{33000}$, or 0·16 horse power. Let us suppose that a rider, when bent down into the racing position, represents about 3 square feet of front vertical surface, and that the wind pressure at 60 miles an hour is even less than that given by Smeaton's original formula, or say only 15 pounds per square foot, then $3 \times 15 \times 0{\cdot}16 = 7{\cdot}2$ horse power; that is to say, a bicyclist must exert over seven horse power to make a mile a minute against still air. Now, as a matter of fact, it is questionable if any but a few of the crack racing men can exert a full horse power, and they are capable of sustaining this effort only for about an eighth of a mile. Prof. Denton, of the Stevens Institute of Technology, tested one or two powerful riders on the Webb floating dynamometer, and found that an "extremely powerful rider using his utmost effort" could only exert for a few seconds power at the rate of 19,780 foot-pounds of work per minute, while another in a hill-climbing test exerted 21,200 foot-pounds, or say two-thirds of a horse power, but only for a fraction of a minute. The difference (supposing our assumed unit pressure for the atmosphere to be correct) between less than one horse power and over seven horse power represents a part of the work which was being done in the recent trial by the locomotive, which was opening out the atmosphere, as it were, to allow Murphy to ride through it in the body of still air within the shield.

Now applying these facts to a train composed of an engine, tender, and say half a dozen cars, moving at the rate of a mile a minute, we see at once that the accumulated atmospheric pressure on the front of the engine, the front of each car, the front of each set of trucks, and the various projections of ventilators, window recesses, etc., must mount up in the aggregate to an enormous figure, and it is certainly a proof of the extraordinary conservatism of even such practical people as build and operate our railroads that nothing whatever has been done to smooth down and close in our trains, so that the engine should do for the train that follows it what it did for the cyclist Murphy.

For the train to get all the benefit of the "pace" (to use a cycling term) afforded by the engine, the front car should be connected to the engine and each car to the one behind it by a continuous sheathing, similar in cross-section to the shield built for the recent bicycle trials. Sheathing should also extend from the sides of the cars to the rails, as in the wind shield, and this sheathing should be continuous from the pilot of the engine to the rear steps of the last car. The train would thus be vestibuled from the roof to the rails and from the pilot to the rear platform, and the result would be that the total front vertical area opposed to the atmosphere would be reduced about three or four hundred per cent. As trains are now built, the air that is pushed aside by the engine closes in upon the first car, and upon the front of every car that follows it. Each truck also, and all of the brake gear, etc., add to the total resistance, until we think there is little reason to doubt that at high speeds the resistance of the air exceeds by many times the internal and the rolling friction of the train.

The best work, indeed the only exhaustive work upon the subject, is that written by Frederick U. Adams a few years ago, after an exhaustive and costly experimental study of the problem. At a speed of 60 miles an hour he estimates that the total front surface exposed squarely to the wind on a six-car Pullman train is 605 square feet, and the total air pressure 11,374 pounds. He urged upon the railroads the necessity for building their trains with a wedge-shaped front and flush and continuous sides extending to the rails, with vestibuled connections, and an absence of all deep recesses for windows and ventilators. It is a curious coincidence that the cross-section of the car proposed by Mr. Adams is almost identical with that of the shield built for the bicycle trial.

It is strange that with all of our earnest effort to reduce fuel expenses and increase the hauling power of our locomotives, by improving the track, compounding the cylinders, enlarging the boiler and so on, we have taken not one of the obvious and simple precautions by which the greatest of all train resistances might be overcome.

If at 60 miles an hour 7 horse power is consumed on the 3 square feet surface of a bicyclist, how much is consumed on the 400 to 600 feet front surface of an express train of the same speed? We commend the subject to the consideration of our master mechanics and railroad superintendents throughout the country.

EXTREME RANGE OF SIXTEEN-INCH GUN.

The great 16-inch 126-ton gun building for the United States at the Watervliet arsenal will have a range power of 20·978 miles. This statement is based on a calculation made by Major James M. Ingalls, the greatest recognized authority on ballistics in the United States army and the present head of the Artillery School for Officers at Fort Monroe. Major Ingalls has prepared a firing table for the 16-inch gun, which shows that a range of 20·978 miles is attainable on a muzzle velocity of 2,600 foot-seconds. The angle of elevation necessary for the piece he estimates at 40 degrees. The trajectory, or path described by the projectile, which Major Ingalls has plotted shows that in ranging to 20·978 miles the shell will reach a maximum elevation of 30,516 feet. The weight of the projectile he assumes to be 2,370 pounds.

On a muzzle velocity of 2,000 foot-seconds Major Ingalls' calculations show a range obtainable of 13·971 miles. This latter range yields a maximum elevation in flight of 19,302 feet. As in the former case, the gun attains the lesser range on an angle of elevation of 40 degrees. The importance of Major Ingalls' calculations may be better understood when it is known that the greatest range ever attained in the world was recorded by a Krupp 9·45-inch gun on the Meppen range in Germany. The shot was fired in the presence of the Emperor on April 28, 1892. The range was measured and found to be 22,120 yards, roughly, 12½ miles. The greatest height reached by the Krupp shell in its flight was 21,456 feet. The time occupied between the firing of the gun and the striking of the projectile was 70·2 seconds. The German artillerists pointed with pride to the fact that had the German gun been placed at Pre St. Didier in the Alps, with an elevation of 44 degrees, and fired, its shell would have ranged 8,956·8 feet higher than Mont Blanc, and its fall would have been in the neighborhood of Chamounix.

Prior to the Meppen shot, the greatest range ever attained was recorded by a 9·2-inch English gun at Shoeburyness, England. The gun was fired on the occasion of the Queen's Jubilee, at 12 o'clock noon. Several months before the date of firing, the English officials sent out data to the recognized artillery experts of foreign countries, and the request was made that the range of the shell be calculated. Major (then Captain) Ingalls was handed the English data, as the officer selected to solve the problem for the United States army. Major Ingalls worked alone, and when his calculation was made, it was duly sealed and forwarded through the diplomatic channels to the British War Department.

It was understood from the first that the papers were not to be opened until after the shot had been fired. To enable the foreign officers to calculate the more closely, the English authorities furnished all possible data in advance which might be needed. The data set forth the type of gun, weight of shell, nature and weight of charge, angle of elevation, and a table of atmospheric readings, showing what conditions had prevailed at Shoeburyness for ten years back for the hour on corresponding days on which the shot was to be fired.

The range attained by the English shot was about 12 miles. When the papers of the foreign officers, as well as those of the English officers, were opened, it was found that the closest calculation of all had been made by Captain James M. Ingalls. The next best calculation was turned in, it is understood, by an Italian artillerist. Captain Ingalls plotted the fall of the shot only a few hundred feet short of the actual distance. The rival calculations placed the point of fall at distances varying from 1,500 yards short to several miles short. On overlooking the data of the firing with the actual conditions of weather which prevailed at Shoeburyness, on the day in question, Captain Ingalls was able to place the shell practically at the very spot where it struck. In his previous calculations he had worked up the problem, using the mean average atmospheric data for the ten years past. From the artillerists' standpoint, Ingalls' wonderful showing has never been equaled, and it is doubtless a fact that this officer is more appreciated for his great attainments in Europe than he is in the United States. Ingalls' works on ballistics have been translated into a number of languages, and are standard text books, it is said, in many foreign services.

The calculation which has just been made by Major Ingalls regarding the new 16-inch gun is all the more interesting in view of the estimate made not long ago by an artillery expert of the Krupps, who expressed doubt of the American 16-inch gun being able to attain a greater range than sixteen miles. The German expert admitted that a sixteen-mile range might be reached on a muzzle velocity of 2,600 foot-seconds, but he assumed that the gun must be laid at an angle of elevation of 44 degrees, and this he thought could not be accomplished except on an experimental carriage. It will be noted that Major Ingalls takes issue squarely with the figures of the German expert, and in his table he works out the twenty-mile range on an angle of elevation of only 40 degrees.

In connection with the 16-inch gun data, Major Ingalls has developed a table for the new 12-inch navy gun which shows a range attainable of 19·935 miles on a muzzle velocity of 3,000 foot-seconds. The maximum elevation plotted for the 12-inch shell is 32,515 feet. The weight of the 12-inch shell he assumes to be 850 pounds.

SCHENECTADY LOCOMOTIVES FOR ENGLAND.

The first of the ten freight locomotives which the Schenectady Locomotive Works are building for the Midland Railway, England, has a decidedly handsome appearance, and impresses us more favorably in this respect than the engine built for the same company by the Baldwin Company, the first of which was illustrated in the SCIENTIFIC AMERICAN of May 20. The designers have paid that careful attention to contour and general outline which characterize all the Schenectady engines, and while we do not suppose there will be anything to choose in the excellence of the workmanship of the two the Schenectady locomotive is certain to find greater favor with the English people, who place such high store upon the neat appearance of their engines. The running-board is slightly below the level of the tops of the drivers and extends straight without a break from the cab to the forward end of the steam-chest, upon which it rests. There it curves down and forward to the bumper beam. The cab is of metal; its sides flush with the outer edge of the running-board. It is of the standard American type, with four windows in front and two on each side. Inside the English engineer will find the American arrangement of throttle and reversing-lever, and he will be given an opportunity to compare them with his own system. The cylinders, 18 by 24 inches, are outside the frames, with the steam-chest on top, instead of, as in English practice, on the side. The bell and sand box on the top of the boiler are missing, the former because it is never used in England and the latter because it is replaced by smaller sand boxes, two on each side, beneath the running-board. These are placed in front and to the rear of the main driver, and each is supplied with a steam sanding device which blows a fine spray of sand under the tread of the wheels. The locomotives are of the Mogul type, with a single pair of leading wheels and six wheels connected. The tender is of the standard six-wheeled English type.

The firebox and staybolts are of copper, as are also the tubes. This metal is used because of its great wearing qualities, the firebox outlasting, with good usage, the other parts of the engine.

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CORROSION OF ALLOYS IN SEA WATER.

A series of exhaustive tests to determine the corrosion of certain alloys and metals have just been completed by the German Admiralty. The tests were carried on for a period of two years and were marked by the great care which characterizes all German expert investigations; hence the conclusions are of unusual value, particularly as experimental data on this subject is necessarily somewhat meager.

In the case of each alloy or metal a dozen strips were used, nine of them being placed in the sea water and three reserved for comparison as to quality and strength. At the end of every eight months three strips of each kind were removed and placed in the testing machine in comparison with the strips which had not been immersed. In this way it was possible to determine accurately the amount of deterioration due to stated periods of immersion. Other tests were made by exposing specimens of alloys that contained a large percentage of zinc to the free action of the atmosphere. The alloys represented in the tests were of the following character: Copper alloys rich in zinc, bronzes containing little zinc, pure tin bronzes, pure aluminum bronze, and iron-aluminum bronze.

The results were as follows: In the experiments on atmospheric deterioration it was proved that while iron-bronze alloys suffered practically no injury in two years' exposure, those alloys which contain much zinc are more subject to decay. Of the specimens immersed in sea water in contact with iron, the iron, tin and aluminum bronzes showed very little deterioration. After from two to two and half years' submersion, there was no marked difference in appearance, no loss of weight and no reduction of strength. Iron bronze in contact with tin bronze showed a serious loss, one specimen in two years' immersion losing two-thirds of its strength and four-fifths of its elongation, the material being partially destroyed by the dissolving out of the zinc. Similar effects were shown in the case of cast and wrought bronze. A wrought plate of iron bronze submerged in contact with a cast plate of the same material lost about sixty per cent of its strength in two years.

The conclusion deduced by the Admiralty from these tests is that the corrosive action between different metals depends upon their relative position in the electrical scale, the electrical relation of the metals in respect of corrosion being the same as in galvanic action. Thus pure aluminum bronze, which is practically proof against the corrosive action of sea water when in contact with metals which are electro-negative toward it, is quickly destroyed while in contact with electro-positive metals. Hence, it is best in the case of metals or alloys that are to be subjected to the action of sea water, to place only those in contact which are near to each other in the electrical scale.

GROWTH IN SPEED AND SIZE OF OCEAN LINERS.

It is an extremely rare occurrence for a new transatlantic liner to be thrown upon her builders' hands because of her failure to come up to contract requirements as to speed; indeed, in the past twenty-five years, there have been only two instances—one in the case of the "City of Rome," and the other in the case of that splendid ship, completed only last year, the "Kaiser Friedrich," which has now been rejected because of her slow speed. The "Kaiser Friedrich" is one of two vessels ordered by the North German Lloyd Company for their fast line. The first of these was the very successful "Kaiser Wilhelm der Grosse," built by the Vulcan Company at Stettin. She is 649 feet long, and her engines of 28,000 horse power have driven her across the Atlantic at an average speed of 22·3 knots an hour. The order for the "Kaiser Friedrich" was placed with Schichau, of Elbing, whose fast yachts and torpedo-boats have won for him a world-wide fame. She is 600 feet long, and her engines of 25,000 horse power were to have driven her at one-half a knot higher speed than the "Kaiser Wilhelm." As a matter of fact, the contractors have never been able to get a better average out of the boat than about 20 knots for the whole passage. The fault is attributed to the location of the engines amidships, and the unusual length of shafting which this necessitates. During our visit to the ship on her maiden trip we were struck with the fact that Schichau appeared to have simply reproduced the standard torpedo-boat design of engine on a very big scale. The valves of the ordinary slide pattern were very large and heavy, and cut badly on the maiden voyage.

Following closely upon the announcement of her rejection is another to the effect that the North German Lloyd people have ordered another vessel from the Vulcan works, which is to exceed the "Kaiser Wilhelm" in size and speed. The new ship is to be 700 feet long, 70 feet in beam, and is to make twenty-three and a half knots with engines of 36,000 horse power.

The new ship will thus be slightly larger and faster than the "Deutschland," building for the Hamburg-American line, illustrations of which appeared in the SCIENTIFIC AMERICAN of July 1, 1899. Although the new ship will be of practically the same length and of two feet more beam than the "Oceanic," of the White Star line, her displacement, on account of the fineness of her lines, will be less.

The American line, the total loss of whose fine vessel the "Paris" was announced in our last issue, evidently considers that smaller ships of a slower speed are more profitable investments, while seventeen knots an hour is fast enough for the average transatlantic passenger. This company has recently ordered from Clyde yards four 12,000-ton ships of seventeen knots speed and two somewhat smaller ships from the Cramps of Philadelphia. In respect of speed the company are following the lead of the White Star line, who were satisfied with 20 knots in the "Oceanic" and about 15 knots in the "Cymric." As to whether the high speed or moderate speed ship is to be the type of the future time will tell. With the Parsons turbine demonstrating its possibilities and speeds of 35 and 40 knots promised on half the weight of motive power per horse power, he is a bold prophet who will say that the era of the ocean "flier" is drawing to a close.

ELECTRIC HEATING.

BY ALTAN D. ADAMS.

The electric heater has an efficiency of 100 per cent; it transforms into heat all of the electric energy sent into it. No other device for heating returns anywhere near so large a share of the energy supplied. A first-class water-tube boiler supplies in steam from 70 to 80 per cent of the possible heat from fuel burned under it; ordinary cylindrical boilers furnish as steam but from 50 to 60 per cent of the heat contained in their fuels, and it is probable that the heat from steam and hot water house boilers seldom rises above 40 per cent, and from stoves above 30 per cent of that resulting from perfect combustion.

On the score of convenience the electric heater is easily first, as its maximum heat can usually be attained in one minute or less by simply turning a switch, and can be entirely discontinued instantly in the same manner.

Another point of convenience is that the electric heat, when used for some particular purpose, as for boiling, broiling, smoothing irons, soldering coppers, and many other purposes, is developed directly in the thing to be heated, as the stew pan or smoothing iron, so that a constant temperature in the article is maintained and no time lost while it is heating or in carrying it to and from a fire.

Electric heaters, being entirely free from the presence of combustion, produce none of its undesirable effects in the way of noxious gases, and a high degree of safety is assured by the complete absence of sparks and flame.

The care of an electric heater amounts to nothing, as there is neither fuel to supply nor products of combustion to remove. With the important qualities of efficiency, healthfulness, cleanliness, and convenience all in its favor, electric heat may seem about to displace all other forms, and opinions to this effect are sometimes heard; but quite the opposite is in fact the case, and must continue so until there is a complete change in the art of producing electric energy. At the present time the only practical source of electrical energy in any considerable quantity is the dynamo, and the dynamo requires energy in a mechanical form to operate it, and the main source of this mechanical power is the steam engine and boiler, so that ultimately the fuel burned under the boiler supplies the heat energy given off by the electric heater.

Now, although the electric heater has an efficiency of 100 per cent, there are losses in every other transforming and transmitting device between it and the steam boiler, and the sum total of these losses must be considered in order to show what part of the heat produced by combustion under the boiler is available at the electric heater. Taking the efficiency of the best boilers at 80 per cent, steam engines at 17·5 per cent, dynamos at 90 per cent, and transmission conductors at 95 per cent, the electric heater will furnish that fraction of the total heat of combustion represented by $0{\cdot}80 \times 0{\cdot}175 \times 0{\cdot}90 \times 0{\cdot}95 = 0{\cdot}1197$ or 11·97 per cent. If engines and boilers of only ordinary efficiency are used, say 70 per cent for boilers and 12 per cent for engines, the figures become $0{\cdot}70 \times 0{\cdot}12 \times 0{\cdot}90 \times 0{\cdot}95 = 0{\cdot}072$ or 7·2 per cent for relation between energy of the electric heater and the total energy of combustion.

To sum up the above, the per cents of total combustion energy which may be obtained from the several heating devices, when used in the same establishment, are about as follows:

Steam heat with good boilers	70 per cent.
Steam heat with ordinary house boilers	40 "
Hot water heat with ordinary house boilers	40 "
Heat from stoves	30 "
Heat from electric heaters	7 "

It may now be inferred, from the great losses between the combustion at the boiler and the electric heater, that electric heat can have no extended use; but this conclusion would be as incorrect as the one which supposed the electric heater about to occupy the entire field.

Where dynamos must depend for their power on the steam engine, the cost of electric energy above shown obviously puts it out of the question for the general heating of buildings in competition with coal and wood. There are many applications of heat to the arts, however, where the case may be different. The fact is that in many cases the cost of heat for cooking and mechanical operations is only a small part of the total cost, which is usually that for labor, and the saving in labor through constant readiness and instant control of the heating devices frequently amounts to more than the entire cost of electric heat. Another fact which reduces the comparative cost of electric heat for many purposes is that only so much heat need be expended as is necessary to maintain the thing to be heated at the desired temperature, as for instance a smoothing iron. When heat other than electric is used, it is commonly necessary to maintain combustion in some stove or heater, which wastes much more energy than is actually used in the device which is taken to the fire to be heated. In many cases of this sort the actual cost of fuel is greater than that of electric energy necessary to heat the required device, to say nothing of the saving in time.

Electrically heated tools and cooking dishes are already widely in use, and in many cases are doing their work at less cost than is possible in any other way. Thus far electric heat has been considered with reference to its actual cost of production; but this only applies to large users who have their own electric plants and secure energy in the electric form without profit added to its cost.

The majority of individual users of electric heating apparatus must purchase electric energy from the public supply, and the cost to them, also the relative cost of gas for the same work, is therefore of interest. Strange as it may seem, electric energy can be had at a lower rate for electric heating than for electric lighting in some, if not all, of the large cities; thus while for incandescent lighting a charge of from 10 cents to 15 cents per thousand watts per hour is commonly made, when the energy is to be used for heating it is sold at a rate of about 4½ cents per thousand watts per hour.

Now, one thousand watts during one hour delivers electric energy equivalent to 3,440 heat units, a heat unit being simply the amount of heat necessary to raise one pound of water 1° F. in temperature, when the water is at about 39° F. temperature.

The heat units per cubic foot of illuminating gas vary somewhat, but may be taken at seven hundred, this being about the value for New York gas. At $1 per thousand, or one mill per cubic foot, for gas, 4½ cents, the price of one thousand watts for one hour, electric energy, will pay for forty-five cubic feet of gas, containing, when perfectly burned, $700 \times 45 = 31{,}500$ heat units, or $31{,}500 \div 3{,}440 = 9{\cdot}1$ times the heat equivalent to electric energy of the same value. The facts that when gas is burned for heating purposes the combustion is not perfect, and further that a large per cent of the energy of combustion escapes with the hot air and gases up the chimney, probably operate to reduce above ratio about one-half; but even this leaves the gas much cheaper for purposes of general heat. In the matter of heating various tools used in the arts, the advantage for cost of heat alone seems to be with the electric method, as all of the electric heat is produced in the thing to be heated, while the heat from gas not only goes in part up the chimney with hot gases, but even a larger part goes into the gas stove and the air of the room, so that probably not one-tenth of the possible heat from the gas actually is absorbed by the device to be heated.

In construction the electric heater is cheap, simple, and inexpensive, consisting usually of iron wire of the proper size and quantity, closely coiled and insulated in its desired position on fireproof supports. For purposes of general heating, as in electric cars and other places, the iron heating coils are usually exposed to the air, which constantly rises from them as from steam radiator pipes.

When electric heat is applied to a tool or cooking dish, it is desirable to have the iron heating coil in very compact form and beyond the reach of accidental contact; so for these cases a coil of much finer wire than would be used if exposed to the air is commonly embedded in a thin layer of fireproof enamel fused at a high temperature on the surface, either inside or out of the thing to be heated. This insulating and supporting enamel conducts the heat from the fine wire much faster than the heat could escape were the wire exposed to the open air, and thus permits wires to be used in the enamel that if exposed to the air would be immediately fused by the heat resulting from their electric energy.

NUTTALL has determined that the smell of freshly turned earth is due to the growth of a bacterium, the Cladothrix odorifera, which multiplies in decomposing vegetable matter, and more rapidly in the presence of heat and moisture. Hence the odor is especially marked after a shower, or when moist earth is disturbed. In dry soil the development of the bacterium is arrested, but it is immediately resumed with vigor as soon as moisture is restored.

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THE LATEST LIQUID AIR PLANT.

BY PROF. W. C. PECKHAM.

A very considerable addition to the appliances for liquefying air and other refractory gases has been made in the plant of the General Liquid Air and Refrigerating Company, which has just been completed and put into operation in New York city. A brief notice of its first production of liquid air appeared in our issue of June third.

We have known the plans for this machine for some time, and have felt certain of its success when it should be started. We have, however, deferred giving our readers any information concerning it till that information could be given upon the basis of an actual result.

We are now able to present a full description of this very interesting plant, with actual tests made in the presence of the writer. The data for this description have been furnished and the copy has been read by the inventors of this system of liquefaction, so that our readers may rely upon it as correct. The inventors are Messrs. Ostergren and Berger, of New York city. Mr. Oscar P. Ostergren is a graduate of the Royal Institution, Stockholm, Sweden, and has followed the profession of naval designer. Mr. Moriz Berger, the associate of Mr. Ostergren, was graduated at the Royal Polytechnic School of Munich. Mr. Ostergren states that he began to work out his design for a liquid air plant in 1896, several years before public attention was called to the subject.

We pass over the details of the filtering, purifying, cooling, drying, and separating apparatus, as simply auxiliary, and liable to be changed at any time, when experience shall suggest improvements. All of these parts, however, show great ingenuity in design. At every point throughout the works regulating and safety valves are provided, and pressure gages enable the engineer to see at a glance the exact working condition of the machinery.

We present quite fully the liquefying apparatus, since it is in this that the chief novelty is found. This part of the apparatus is protected by patents, both in the United States and in the principal foreign countries. It is claimed that these are the only patents which have been granted in the United States up to the present time upon apparatus for liquefying air or other gases.

The compressors for this plant were built by the Ingersoll-Sergeant Company, the larger one from special designs, made for the purpose. The quadruple compression system is employed, divided between two independent compressors, No. 1 and No. 2, Fig. 2. Compressor No. 1, shown in this figure, has air cylinders 18¼ inches and 12 inches in diameter respectively. The initial air pressure in the first compressing cylinder varies from zero to 10 pounds per square inch absolute, as may be required, at which pressure the air enters partially from the air compressor and partially from the atmosphere at such a reduced pressure. The second compressing cylinder brings the pressure up to 80 pounds per square inch, with a piston speed of 300 feet. The power required for this compressor aggregates about 60 horse power.

Compressor No. 2, shown in figure 2, has air cylinders 7¾ and 7 inches in diameter respectively. The initial pressure in the 7¾-inch cylinder is 80 pounds per square inch, and this is raised to 300 pounds terminal pressure, which is the initial pressure of the fourth and last cylinder. This fourth cylinder receives all the air from the third cylinder, the rest of the displacement being supplied by the return current from the liquefier, as will be shown later. In this cylinder the charge is compressed to 1,250 pounds per square inch, which is the pressure usually employed in the machine. The indicated horse power of compressor No. 2 is about 100 horse power. The total horse power used by the two compressors is thus about 160 horse power. This exceeds any plant hitherto reported by about 50 per cent. This is by far the largest liquid air plant in the world.

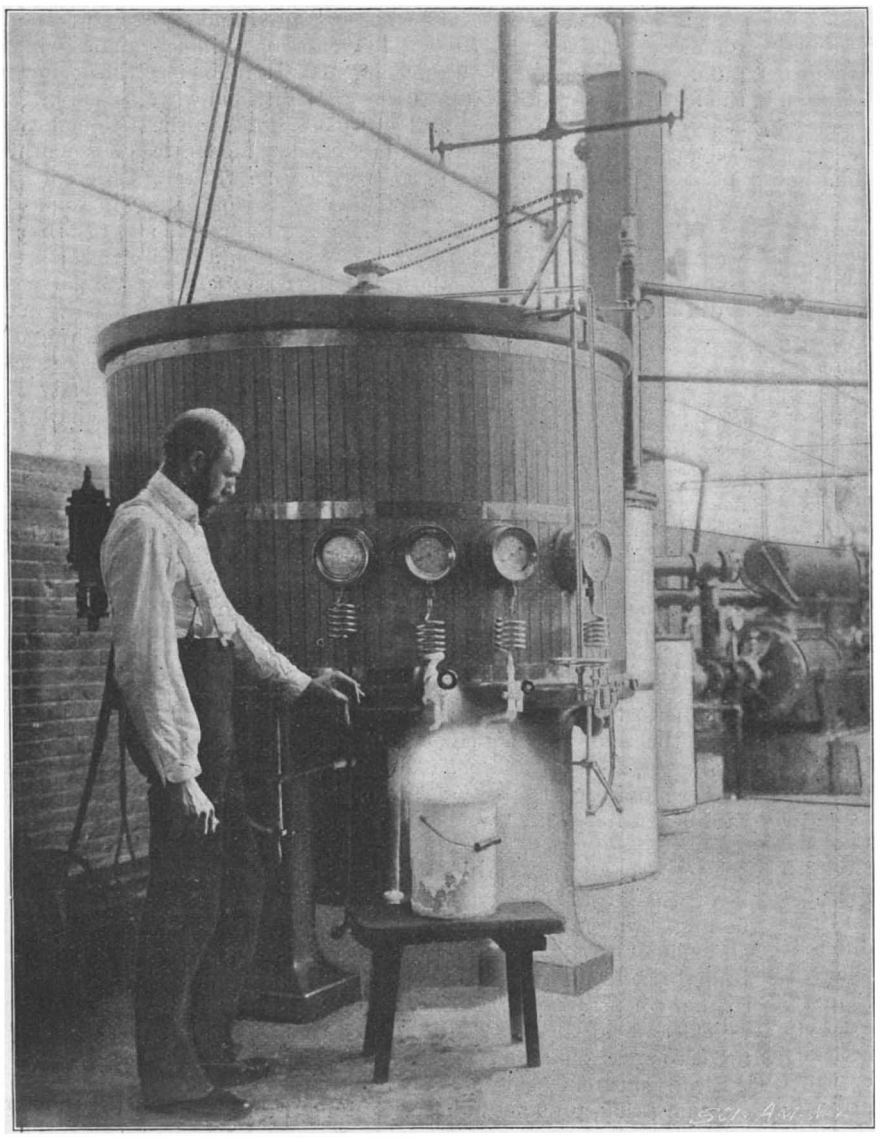

Fig. 1.—COMMERCIAL PRODUCTION OF LIQUID AIR—THE OSTERGREN AND BERGER LIQUEFIER.

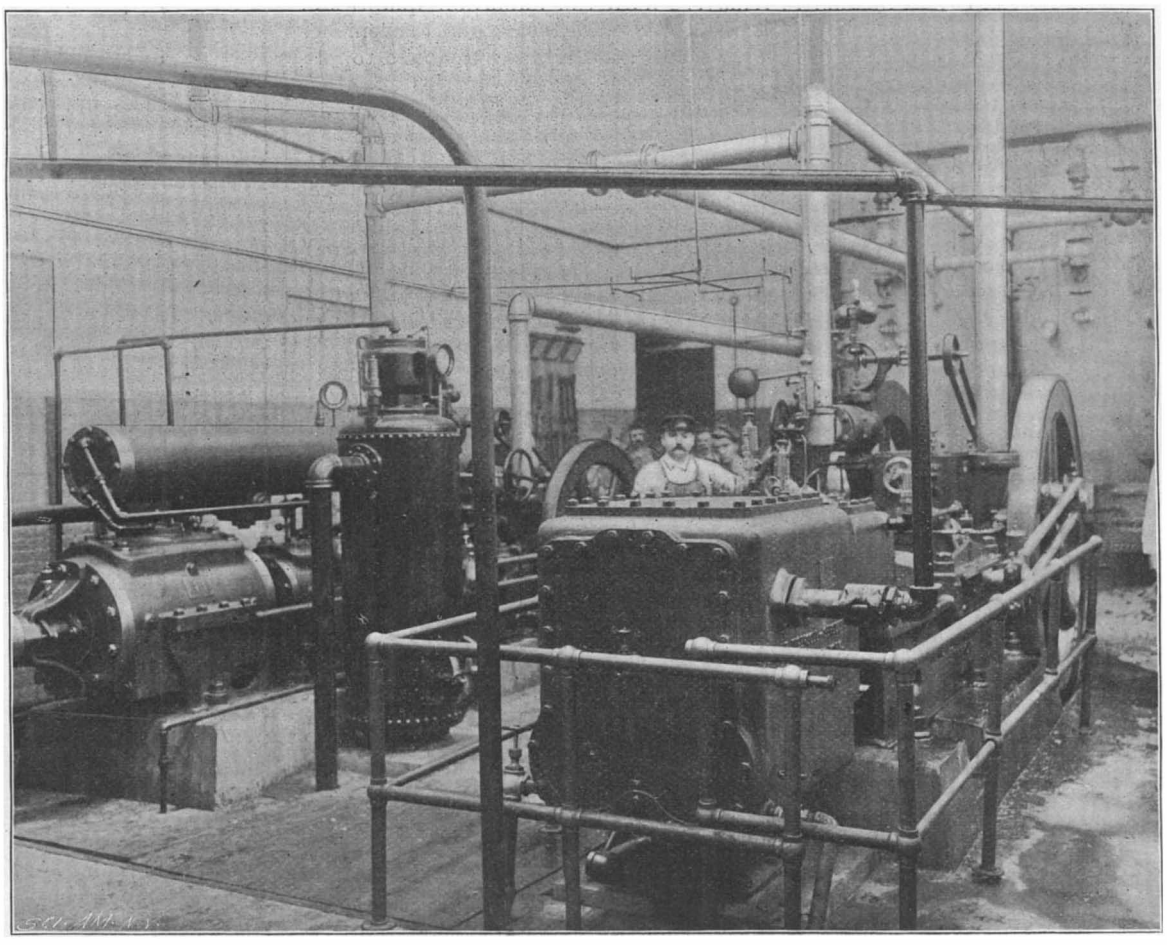

Fig. 2.—GENERAL VIEW OF THE COMPRESSORS.

The air as it passes from one compression cylinder to another is cooled in the ordinary manner by water jackets. The inflowing air from the external atmosphere is passed through an air filter, shown in our sectional view of the apparatus, Fig. 5, to remove its mechanical and other impurities, before entering the compressors.

After leaving the compressors the air passes to the brine or equalizing tank, Fig. 5, where the coil through which it flows is in close contact with the coil which carries the expanded air from the liquefier back to the fourth compression pump. In the brine tank the temperature of the air under high pressure is reduced nearly or quite to that of the expanded air in the return coil.

From the brine tank the air enters a tall separator, Fig. 5, in which the moisture, oil, and any other impurities are removed from it. Here it bubbles up through a tank of water and passes a system of baffle plates, which have satisfactorily performed the work for which they were designed. From the separator the air enters the condenser, or liquefier, at the temperature of cool water, and under a pressure not to exceed 1,250 pounds per square inch.

In the air condenser, or liquefier, there is a complete departure from former models. The system employed is that of "self-intensification of cold," as it has been termed, which appears to have been first employed by Cailletet in 1877 for liquefying oxygen, and which is fundamental in all the machines which have produced liquid air in considerable quantities. A portion of the air under high pressure is allowed to escape from a valve as in Linde's machine, and is expanded, while its pressure drops from 1,250 pounds to 300 pounds per square inch. There is thus produced a large and continuous fall of temperature which ultimately causes that portion of the air remaining in the high pressure system of pipes to liquefy. While this method of cooling a gas below its point of liquefaction is not new, the design of the apparatus and the attention to the details of economical working are novel, and differentiate it completely from its predecessors. A detail drawing, both in plan and elevation, is presented in Figs. 4 and 5, showing its completed form. It is about 7 feet high and its upper part is 6 feet in diameter.

The object had in view by the inventors was the most complete insulation from the heat of the external atmosphere during the process of liquefaction, and also the under-cooling of the air to such an extent that it would not at once return to the gaseous condition again upon being drawn out of the liquefier. In all previous machines the air has been brought only to its boiling point, or at best a very little below it, in the liquefier, and when drawn out into the open air, it boils with great violence and a considerable proportion returns to the gaseous condition, nor has any one hitherto succeeded in preventing this waste to any great extent.

In our sectional elevation of the liquefier, Fig. 4, the cooling of the air to the point of liquefaction occurs in the upper or larger, and the under-cooling takes place in the lower or smaller portion. The current of air under a pressure of 1,250 pounds to the square inch enters the liquefier through the standpipe on the right, from which 36 copper tubes of ⅝ inch diameter and 200 feet long lead in flat spirals toward the center of liquefier, as shown in the plan, Fig. 4. Here they connect with a casting containing two concentric chambers, with a regulating valve between the two chambers. This valve is controlled by the wheel shown at the top of the liquefier, Fig. 5. Passing this valve, the pressure drops from 1,200 to 300 pounds per square inch, and the greater portion of the air at this reduced pressure flows through the second chamber of this casting as a return current into a similar set of 36 tubes to the exit pipe, and so goes back to cylinder No. 4 of the compressor to be raised to 1,200 pounds and sent on its round again. The two sets of spiral tubes are soldered firmly together thus forming a vertical wall of 72 tubes, and inclosing a spiral space leading from circumfer-

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ence to center of the liquefier. An important use is made of this space, as will be seen later.

The heat of the inflowing current of air under high pressure is absorbed by the returning low pressure current which has been cooled by its passage through the regulating valve and its expansion on its return path. This action is so complete that the inflowing and outflowing current have practically the same temperature in the pipes just outside of the liquefier, as has been mentioned above. From the chamber just below the regulating valve a part of the air, which is under a pressure of 300 pounds and either liquefied or just on the point of becoming liquid, is allowed to expand a second time to a pressure of 10 pounds absolute in the under-cooler, which is seen below the liquefier in the sectional drawing, Fig. 4. The portion of the air which is expanded the second time is drawn out of the under-cooler as return current No. 2 by the suction of compressor No. 1, passing through the channel formed by the spiral turns of the wall of 72 tubes described in the liquefier, thus keeping the space around and between these tubes at a very low temperature. This expanded air enters again upon its round of compression and coolings, and in its turn contributes to the liquid product of the machine. The total cooling surface inside the liquefier is 2,200 square feet.

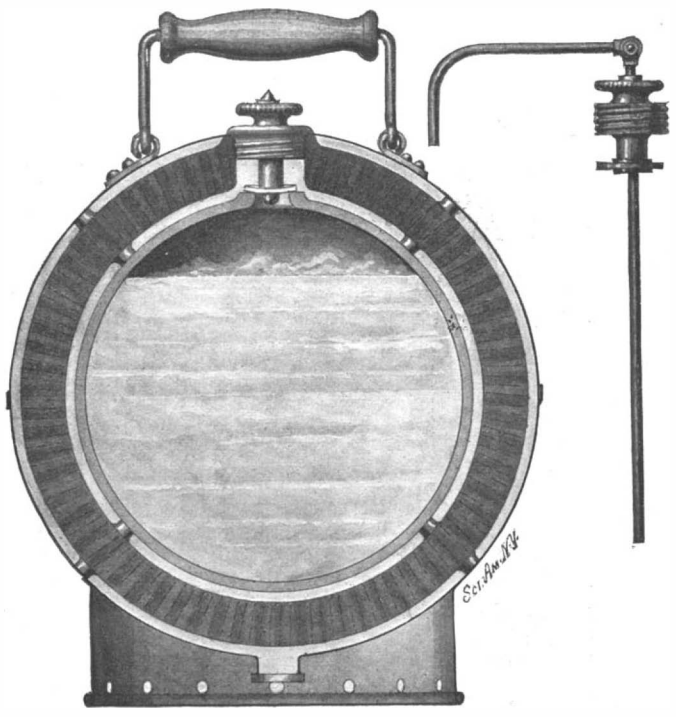

Fig. 3.—PORTABLE VESSEL FOR TRANSPORTING LIQUID AIR.

It will be seen that there is no waste of air which has once been compressed and partially expanded and that the only loss of air in the machine is the quantity of air which is liquefied. This is supplied from the atmosphere in the manner described above. It will be noticed also that the portions of the apparatus in which the liquefaction and under-cooling take place are most completely protected from the accession of external heat by means of the return current from the under-cooler of very cold air, expanded to a pressure less than normal by the suction of compression pump No. 1, which produces a vacuum from zero to 15 pounds as may be desired. It is thought that the liquid air could even be frozen in the lower portion of the under-cooler, by evaporating liquid air in the vacuum produced by pump No. 1.

The importance of the spiral space between the coils of pipes in both the liquefier and under-cooler will now be seen. It is traversed continually from center to periphery by a current of cold and rarefied air, which thus surrounds the working parts of the machine and insulates them from external heat, so that no especial packing is required, as is necessary in all other liquid air machines. But the production of liquid air is a matter of small moment unless some means for preserving it can be devised. This has been provided by Messrs. Ostergren and Berger in their receptacle for liquid air, Fig. 3, upon which the claim has been allowed in the United States Patent Office. Numerous forms and sizes of these receptacles have been designed for special uses. The largest one built up to this time has a capacity of 40 gallons. Our illustration shows one which will hold 3 gallons. The central vessel is a sphere of copper. This is surrounded by an air space in the form of a spherical shell. Outside of this is an insulating layer which may be composed of any desired material.

This in turn is surrounded by another air space between the insulating layer and the external vessel. A poppet valve closes the opening into the inner vessel, which may be adjusted to any desired pressure. The expanding vapor from the inner vessel lifts the valve and passes into the space surrounding the vessel of liquid air. In order to reach the external atmosphere this vapor of air must pass through the insulating layer and then fill the external spherical air space. To emerge from this it must open a valve shown in the bottom of the receptacle, which is adjusted to work at any desired pressure. Thus the air expanding from its liquid form is made to cool the entire external space surrounding the liquid in the interior of the receptacle, and in order that heat from the atmosphere may enter the receptacle, it must pass in the opposite direction to the air which is escaping from the receptacle. To the receptacles pressure gages may be attached. For the purpose of removing the air, a tube extending to the bottom of the receptacle is provided, which operates upon the same principle as the so-called siphons of mineral waters.

Much curiosity has been felt to see the actual operation of machinery so carefully designed and constructed. The test of a full run has however been delayed from time to time by slight changes and repairs, such as are always unavoidable in new machinery. On Thursday, June 22, a trial was made, steam was turned on, and the compressors started. In about two hours after, liquid air was produced in such a quantity that it flowed from the outlet in almost a continuous stream. This was kept up for nearly five hours. No actual measurement of quantity could be made, since receptacles were not at hand for retaining it; but certainly the output was very large.

An interesting experiment was made by opening the valve at the top of the liquefier, which showed that even in that part of the machine the temperature of the air was so low that it could be liquefied by allowing it to expand. The jet of escaping air liquefied, as could be plainly seen. There was distinct stratification, the alternate layers presenting a milky and transparent appearance. There was apparently a set of waves produced by vibrations set up in the outrushing current at the edge of the nozzle.

From the indications of the gages it would seem that the under-cooler could be increased considerably in capacity, and the total output be made correspondingly larger.

As a result of the successful operation of this plant, the company owning it has already an order for a plant to be set up in Los Angeles, California, with a capacity of 1,500 gallons of liquid air a day. This is to be used for refrigeration in the shipment of fruit from Los Angeles to Chicago. In this plant new features intended still further to increase its efficiency will be introduced. The result of this first projected application of liquid air to practical refrigeration, on a scale sufficiently extensive to furnish results definite and valuable as data for future operations, will be watched with much interest.

Our illustrations were made by our own photographer during and after the close of the trial run. Messrs. Ostergren and Berger are to be congratulated for putting up a complicated plant, which has been operated successfully with so short a period for adjustment, especially since they had neither of them any previous experience in making or operating liquid air machinery.

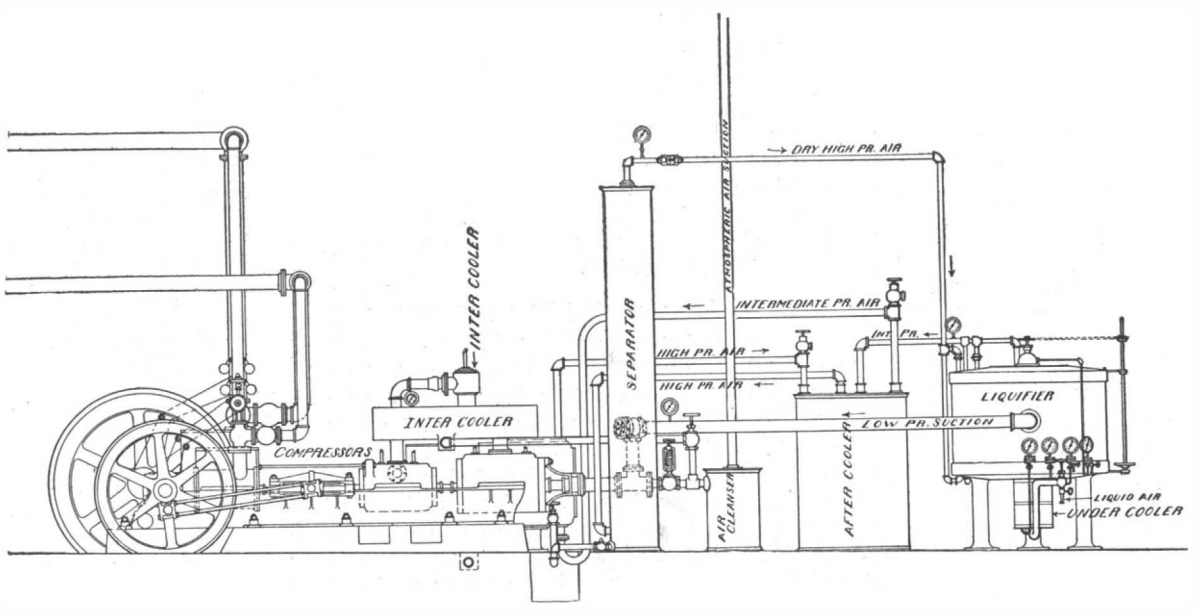

Fig. 5.—DIAGRAM SHOWING GENERAL VIEW OF THE PLANT.

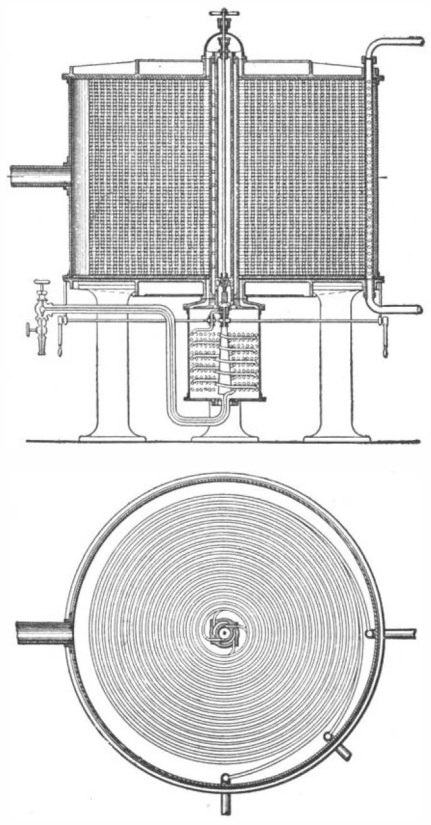

Fig. 4.—INTERNAL CONSTRUCTION OF LIQUEFIER.

Nocturnal Flight of Birds.

A new use for the telescope has been discovered in a new field of scientific observation, that of nocturnal bird flight, and the results are told by Mr. O. G. Libby, in The Auk.

A six-inch glass at the Washburn Observatory, overlooking the largest lake near Madison, Wis., was the instrument used. It was turned upon the moon, and the birds were counted as they crossed its surface. Observations were made on three successive nights in September, each being divided into fifteen-minute periods, and the record for each being kept distinct.

The total number of birds counted in the three nights was 583; of these, 358 were seen in one night. The number varied very much for different hours; the highest, three a minute, was reached at half-past ten, and it diminished to about one a minute at midnight. From that hour the number still declined, though varying at intervals. The prevailing direction up to ten o'clock was almost due south. Between twelve and two in the morning, while two-thirds of the whole number was still moving southward, others were flying toward the eight chief points of the compass.

Toward daylight the numerous calls heard indicated that flocks had been scattered during the hours when fewer were seen.

Taking into account the small size of the moon's surface, compared to the length of its path from east to west, within range of vision, it is reckoned that about 9,000 birds per hour passed during the period of observation. When we compare this path with the entire breadth of country over which the birds migrate, we arrive at astonishing figures, which should go into a bird census.

It was somewhat difficult to identify the birds, for they moved across the field in from one-tenth to one-half a second. Swamp blackbirds and meadow larks were distinguished in greatest number, but sparrows, yellow-hammers and ducks were also seen.

It is interesting to query how the birds are guided; it is suggested that it may be by the stars, or by the contour of the country, lakes, forests, etc. It is certain that they lose their way on cloudy and foggy nights, and not infrequently a strange bird is seen flying with a flock of totally different species.

This field of night study, so full of novelty and interest, need not be confined to owners of telescopes, for good field glasses will show all but the smallest birds.

MILDEW is one of the danger signals that nature hangs out. Whenever and wherever it is visible, be on your guard. It means calamity to all organic life. The only remedy is unlimited fresh air and sunshine.

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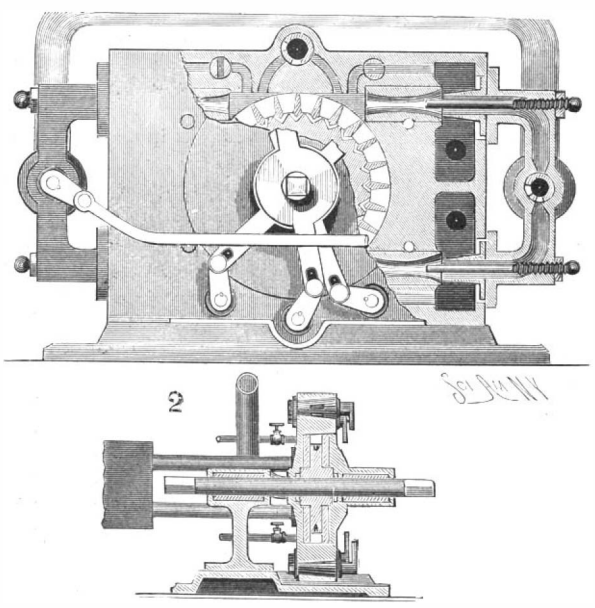
Preservation of Photographic Materials in a Vacuum.

Mr. Steffans has suggested the preservation of sensitized paper and plates in vacuo as a practical means of preservation in the case of articles sent out commercially; an excellent suggestion and one which merely amounts to extending to commercial use that which has long been done in the experimental laboratory. Several sheets of paper may be rolled up and sealed in an exhausted orange-colored glass tube, and even the soldering up of an exhausted tin case is a very easy matter, a method of doing this, which we have frequently practiced, being as follows: The tin casing must be so supported inside as not to collapse, and all being closed by soldering, except a minute countersunk pinhole for exhaustion, the countersink is tallowed, and a small bead of very fusible solder is laid in. A suitable solder is Wood's fusible metal, cadmium 1, tin 2, lead 4, bismuth 7; this melting between 60° and 70° Centigrade. To exhaust the air and at the same time fuse the bead of solder is a very easy matter. A small glass bell jar, rimmed with India rubber and connected with the air pump, is pressed down on a flat surface, and at the right moment a pointed copper soldering bit, which passes through a stuffing box, is brought down on the bead of solder. The whole question merits the attention of those who pack photographic goods, especially for export. In practice, the soldering bit would be heated electrically or by steam, and it must be remembered that a temperature below the boiling point of water is sufficient if the above mentioned solder is used.—Amateur Photographer.

A NEW TYPE OF ROTARY ENGINE.

In the engraving annexed we present two views of a novel rotary engine, driven by the action of a volume of water impelled against the piston by steam jets. Fig. 1 is a partial vertical cross section of the engine. Fig. 2 is a vertical longitudinal section, certain parts being omitted.

The casing of the engine has a central chamber in which the piston turns, and two water chambers on each side of the central chamber. The four water chambers communicate with the central chamber by means of throat tubes, and with a condenser by means of pipes, the same quantity of water being, therefore, constantly circulated through the casing. The water chambers communicate with valved relief passages extending parallel with the throat tubes, and serving to prevent back pressure against the piston. Above and below the piston two by-passes are located, each controlled by a two-way valve. These by-passes serve to regulate the action of the piston. Steam nozzles extend into the throat tubes and communicate with the arms of a main steam-feed pipe having two branches, each of which feeds two of the four arms. Each pair of arms is connected by a two-way valve by means of which the steam may be thrown into any one of the arms or cut off entirely. The two valves are connected to move in unison by means of a connecting rod. Through the steam nozzles and throat tubes valved exhaust tubes pass, which carry off an amount of water equal to the steam condensed. The various valves



SCOTT'S ROTARY ENGINE.

of the relief passages, by-passes, and pipe-arms are controlled by an arrangement of crank arms and levers, as shown in Fig. 1.

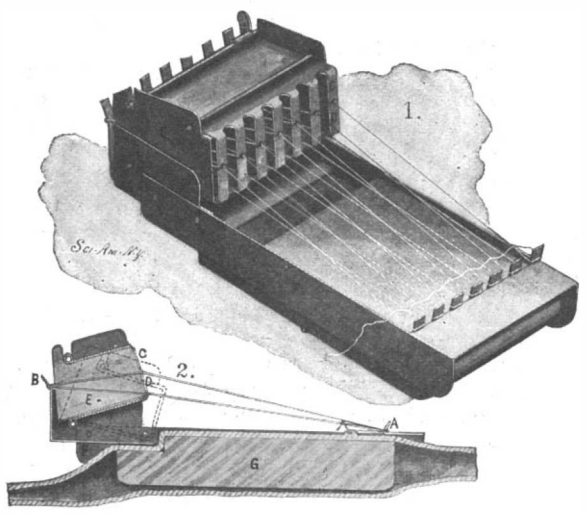
Assuming the valves to be adjusted, as shown in Fig. 1, then the active steam nozzles and water chambers will be those at the upper left hand and lower right hand corners. The steam passing through the nozzles mentioned will draw the water from the corresponding water chambers and impel it against the piston in opposite directions. The back-pressure produced by the action of the steam on the water causes a quantity of water to be forced into the exhaust tubes—a quantity equal to the amount of condensed steam. The four nozzles and water chambers, it will be observed, work in diagonally opposite pairs. The engine is reversed by means of the valves in the steam-pipe arms and the relief passages. The inventor of this engine is Mr. James Scott, 73 Motomachi, Hadokate, Japan.

AN APPARATUS FOR DARNING STOCKINGS.

A machine for darning stockings and other fabrics has been invented by Mrs. Hannah C. Hamann, of 3535 Half Howard Street, Omaha, Neb., which machine is so constructed that the work done is the equivalent of a weave, the darned or mended portion being equally smooth on both sides.

Fig. 1 is a perspective view of the device, and Fig. 2 is a longitudinal section.

The apparatus consists of a main frame, *F*, and a



A DARNING MACHINE.

frame, *E*, pivoted to an auxiliary frame riveted to the main frame. At its front end the main frame, *F*, is provided with a cross-bar having a series of upwardly projecting teeth, coinciding in position and number with teeth formed on a back piece of the auxiliary frame. Notched fingers, *D*, project vertically up from the bottom of the pivoted frame, *E*. From the hinged cover plate of the frame, *E*, notched fingers, *C*, extend downwardly, corresponding in number and location with the fingers, *D*. In connection with the main frame, *F*, a block, *G*, is employed.

In using the device, a square opening is made in the portion of the stocking to be darned; the block, *G*, is passed into the stocking so that the upper face will be beneath the opening in the stocking, and is forced upward into frictional engagement with the main frame, *F*. A warp-thread is then threaded on the teeth of the main frame and of the auxiliary frame, in the manner shown in the illustrations. The loose end of the warp-thread is passed through the eye of a needle, and the needle is passed through the perfect portion of the fabric adjacent to the opening, and under two strands from the inside to the outside of the fabric. The thread is then carried back over one strand and returned again under two strands, the operation being repeated until the end of the opening to be closed is reached. The pivoted frame, *E*, is now alternately raised and lowered so as to produce a changing shed in the arrangement of the warp-threads. The needle is passed between the upper and lower threads of the shed, alternately from one side to the other as the position of the warp-threads is changed, the thread attached to the needle and forming the cross or weft-threads being carried forward. Each time the needle passes back and forth between the separated warp-threads it also passes through the edges of the opening. The thread is drawn properly in place to close the opening and present a surface perfectly smooth on both sides.

An American Blue Grotto.

Many of the beautiful phenomena seen at the celebrated Blue Grotto of the island of Capri are reproduced on a small scale in a cavern at Lake Minnewaska, New York. This lake is situated on the Shawangunk range of mountains at an elevation of about 1,700 feet.

The cavern is formed by several huge rocks of white quartzite overhanging the water so as to form a comparatively dark hole, and the space between the under side of the sloping rocks and the water varies from about two feet to not more than two inches.

The cavern faces the southwest; it is very irregular in shape, and at one point the roof and walls reverberate in response to a deep bass note. The water just at the entrance to the cavern is 33 feet deep, and two or three feet away, 40 feet; it is very transparent at considerable depths. As the rocks overhang so close to the water, the optical effects can only be seen by a swimmer, and it was while swimming along the shore that H. Carrington Bolton discovered the American Blue Grotto three years ago, and described the same in Science. As one approaches the mouth of the cavern the bluish color of the water is noticeable, but the beautiful effects are best seen by entering the opening and looking outward toward the light.

The water varies in color from Nile green through turquoise blue and sky blue to deep indigo blue, and in all these shades exhibits the silvery appearance, when agitated, characteristic of the grotto at Capri. A body immersed in the water has a beautiful silvery sheen, similar to the reflection of moonlight. The water has these colors at all hours, but they are strongest when the sun is in the zenith; late in the afternoon the slanting rays of the sun enter the opening and light up the cavern, greatly diminishing the optical effects.

Another pleasing phenomenon must be mentioned. Just below the water line, where the rocky sides are lapped by the waves, the white quartzite exhibits a brilliant siskin-green hue; this bright color is limited to a space about three or four inches below the level of the lake and to certain walls of the cavern. The bare arm immersed in the water partakes of the green color when the light is reflected at one angle, and of the silvery blue color at another angle.—Science.

AN IMPROVED SASH-BALANCE.

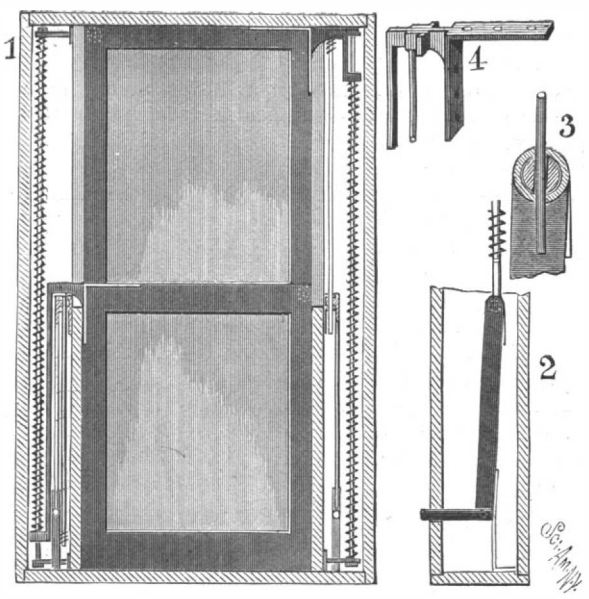
A patent has been granted to Joseph A. Manahan, of 23 East 129th Street, Manhattan, New York city, for an ingenious mechanism by which a window can be automatically operated.

Of the accompanying illustrations, Fig. 1 is a front elevation of a window with the mechanism applied, parts being in section; Fig. 2 is a section showing a detail; Fig. 3 is a section of a locking device employed; Fig. 4 is an enlarged view of the bracket for the lower sash.

To diagonally opposite corners of the two sashes brackets are secured, each provided with a vertical locking-rod and a projecting guide-arm moving on a guide-rod. Coiled around each guide-rod is a spring which acts against the corresponding guide-arm. Each locking-bar slides longitudinally through a lock or clutch (Fig. 3) which consists of a sleeve having a longitudinal bore and a transverse cut. In the transverse cut a pivot is placed which has a perforation corresponding with the vertical bore of the lock, so that the locking-bar passes through both lock and pivot. The locking-bars are normally locked because the pivot is slightly turned or jammed in the lock by the action of the spring-pressed lever (Fig. 2). When the lever is thus held at an angle, the vertical bore of the lock is out of alinement with the perforation in the pivot, for which reason the locking-bar cannot move up or down, but is jammed in fixed position.

In Fig. 1 the sashes are shown in closed position. When it is desired to open either sash, the proper button is pressed against its spring so as to turn the pivot in the lock and release the locking-bar. The coiled spring will then open the sash. When the proper elevation has been reached, the lever is allowed to spring back to hold the locking-bar. A slit is cut along the window-casing for the passage of the brackets and their guide-arms and rods. The closing of the sashes is effected by hand.

The bracket shown in Fig. 4 differs from the upper



MANAHAN'S SASH-BALANCE.

sash bracket, only in having a depending shank, a construction due to the position of the bracket. A mechanism of the character described is particularly applicable to car windows.

Utopia is now known to be located at Orsa, in Sweden. The community has, in course of a generation, sold $4,600,000 worth of trees, and by means of judicious replanting has provided for a similar income every thirty or forty years. In consequence of this commercial wealth there are no taxes. Railways, telephones, etc., are free, and so are school-houses, teaching, and many other things.

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THE RECONSTRUCTED CRUISER "CHICAGO."

The good work of reconstructing the older ships of the United States navy is making fair progress. Not only are we constantly adding new ships to our navy, but we are gradually reconstructing the earlier vessels of the new navy. The "Chicago," one of the first of our steel warships, launched in 1885, was recently placed in commission, after an overhauling and reconstruction that has practically made a new ship of her. Fortunately, the lines of the vessel are excellent for speed and the material and construction of her hull are both first-class and fully warrant the large sum of money that has been expended in improving her speed and fighting power.

There is something very pleasing in the thought that this vessel, the first large steel warship and the first flagship of our modern navy, has been given a new lease of life, and that it has been found possible to make such changes in her motive power and armament that she is able to rank fairly well with cruisers of her displacement that were not built until fully ten years after the "Chicago" had been designed.

It is gratifying to know that a similar overhauling, not quite so complete, perhaps, but still very thorough, is being carried out and is nearly completed on the "Atlanta" (a cruiser built at the same time as the "Chicago"), and that as soon as the exigencies of the service will permit, the "Boston," sister ship to the "Atlanta," will be also rearmed and improved.

The "Chicago" under her new lease of life carries very little of the original material that was put into her at the time of her first construction. Indeed, it may be said that the mere shell of the vessel is all that remains of the work done in Roach's shipbuilding yard. In the first place her engines and boilers are entirely new, and are of an improved and thoroughly modern type. Her protective deck, which formerly extended merely above the vitals of the ship (the engine and boiler rooms), has now been carried forward and aft to the stem and stern, so as to make a continuous armored protection throughout the ship. And not only the main engines, but all the various auxiliaries with their steam piping and general fittings, are entirely new. In the armament only the heavy 8-inch guns have been retained. The whole of the battery of slow-fire guns on the gun deck has been replaced by a battery of fourteen 5-inch rapid-fire guns of the latest navy type, and the secondary battery of 6-pounders and 1-pounders has been disposed to suit the improved arrangements of the superstructure and the fighting tops.

The great change in the outward appearance of the vessel is due to the alteration in her rig. When she returned from her last cruise she carried her familiar bark rig, with heavy yards on the fore and main masts and a complete bowsprit and jibboom. The yards and jibboom have disappeared, and with them the mainmast, so that the ship now carries two masts (fore and main mast) of the usual military type, with a fighting top on the fore-mast in which are carried two 1-pounder guns, and just below the fighting top a searchlight platform, which is sponsoned out in front of the mast. There is a small signal yard on each mast and a gaff on the main-mast. These changes in her rig, together with the lengthening of the smoke-stacks, which now extend some eighty feet above the grate bars, have completely changed the appearance of the "Chicago," and have given her a much more ship-shape and businesslike appearance judged by the modern standards of warship design.

The most important changes in the ship are, of course, those which have been made in the motive power, as may be judged from the fact that the horse power has been raised from 5,000 to 9,000, and the speed from about fifteen up to eighteen or possibly to eighteen and a half knots an hour. The machinery of the original ship was of a curious and cumbersome type. It consisted of two heavy compound engines, the cylinders of which were connected to overhead, athwartship, walking beams, which served to drive the crankshafts on the opposite side of the vessel. Thus the starboard cylinders drove the port screw shaft, and vice versa. The boilers were even more out of date, if that were possible, than the engines. They were of the externally fired return tube cylindrical type, the furnaces being bricked up around the outer shell. The boilers have been replaced by six Babcock & Wilcox water-tube boilers and four Scotch boilers. With a view to testing the merits of nickel steel for boiler construction, one of the Scotch boilers was built of this material, and if the results in respect of corrosion and general durability are satisfactory, it is probable that nickel steel will be largely adopted for boiler construction. The greater tensile strength of the alloy, as compared with common commercial steel, will enable a considerable reduction to be made in the total weight of boilers for a given horse power. The Babcock & Wilcox boilers average about 64,200 pounds in weight, with all attachments, but no water. The weight of water is 11,930 pounds; the total heating surface for the six boilers is 14,700 square feet, and the total grate area is 360 square feet, while the pressure for both types of boilers is 180 pounds. The average weight of the Scotch boilers, empty, is 81,400 pounds; the weight of water is 40,430 pounds, the total heating surface is 8,562·6 square feet, and the total grate area is 273·52 square feet. It is interesting to note that the weight of water used in the Scotch boilers is over three times as great as that used in the boilers of the water-tube type. The total heating surface of all boilers is 23,352·3 square feet, and the total grate surface is 633·52 square feet.

The ship is driven by twin-screw horizontal triple-expansion engines, the engines being slightly inclined. The high pressure cylinder is 33½ inches in diameter, the intermediate 50½ inches, and the low pressure 76 inches in diameter, the common stroke being 40 inches. All the valves are of the piston type, there being one single piston valve for the high pressure and two each for the intermediate and low pressure cylinders. The total indicated horse power is 9,000. The engines are in two separate water-tight compartments, the cylinders being on one side of the center line of the ship, and the screw shafts on the opposite side. Thus the starboard engine, or the engine driving the starboard propeller, has its cylinders lying on the port side of the ship, while the port engine has its cylinders lying on the starboard side.

The ship is provided with a well-found machine shop, in which motive power is furnished by a Greenfield vertical engine. The tools consist of two lathes, two drill presses, one shaper, one emery grindstone, and various machine shop etcetera, besides a well-found bench for vise work.

The system of ventilation has been well worked out. The engine room is ventilated by both exhaust and forced blowing and the ship ventilation is arranged on the same system. The ship is provided with an Allen dense air ice machine, connected to a freezing box and a cold storage room. The coil also passes through the scuttle-butts to provide cool drinking water for the crew.

Of almost equal importance to the radical changes which have been made in the motive power is the extensive rearmament of the ship which has taken place. The old 8-inch guns which are carried in sponsons on the main deck are retained. They are thoroughly serviceable weapons of the same type as those which did good duty at the battle of Manila Bay on the "Baltimore." The gun deck broadside battery of five slow-fire 6-inch guns and four slow-fire 5-inch has given place to a battery of fourteen 5-inch rapid-fire guns. To keep pace with the increased demand for ammunition by the rapid-fire weapons, new electric ammunition hoists have been built into the ship. They are of the endless chain pattern and are capable of putting the ammunition on deck considerably in excess of the ability of the guns.

An interesting installation on this ship is the system of hydraulically operated watertight bulkhead doors invented by Mr. W. B. Cowles of the construction department of the United States navy. This device, known as the "long arm" system, secures doors which will open and close again tightly under a head of water, and they will close tightly through a doorway full of coal. All the doors can be actuated by a single operator, who from his station on deck can move any single member of the system. The advantage of this concentration of control in case of flooding through attack by the ram or torpedo is obvious. An illustrated description of the system as carried out on the "Chicago" will be found in the SCIENTIFIC AMERICAN for June 25, 1898.

The extensive structural changes in the "Chicago" were carried out under Naval Constructor Bowles, and the machinery was installed under the superintendence of A. F. Dixon, chief engineer of the ship.

OUR LATEST BATTLESHIP, THE "KEARSARGE."

About the time this article appears our latest battleship, the "Kearsarge," is expected to arrive at the Brooklyn navy yard, where she will enter drydock preparatory to undergoing her speed trials off the Massachusetts coast.

The "Kearsarge" and her sister, the "Kentucky," will, in some respects, be the most interesting vessels of the new navy; for apart from the fact that they will represent the latest efforts of the Bureau of Construction and Repair and our leading shipbuilders, the vessels possess peculiar interest on account of some decidedly novel features in their design and construction. We refer to the manner in which the main and intermediate batteries are carried, the method of mounting them being known as the double-decked turret system. The system can best be understood by comparing it with the plan adopted in the case of the "Iowa," the latest of the large battleships completed for our navy. In the "Iowa" the main battery of 12-inch guns is carried on the center line of the ship, two of the guns in a turret forward, and two in another turret aft. The intermediate battery of 8-inch guns is carried in four turrets at the four angles of the central armored citadel, amidships. As there are two of these guns in each turret, the intermediate battery is seen to be of a very formidable character.

This arrangement of the main battery in fore and aft turrets, with the turrets of the intermediate battery flanking it, the two 8-inch forward turrets being aft of the forward 13-inch turret, and the two after 8-inch turrets being forward of the after 13-inch turret, also characterizes the three ships of the "Oregon" class. It provides an unusually powerful "end-on" fire, the concentration ahead or astern being, in the case of the "Iowa," two 12-inch and four 8-inch, and in the case of the "Oregon" two 13-inch and four 8-inch guns. In the gun trials of the "Oregon" type, however, it was found that in firing ahead, the blast of the 8-inch guns affected the officers in the sighting-hoods of the 13-inch turrets, if the former were fired closer than within 10° of the longitudinal axis of the ship. This difficulty has been overcome in the case of the "Kearsarge" and "Kentucky" in a novel and somewhat daring manner. Four of the 8-inch guns were thrown out altogether and the remaining four were mounted in two turrets, which were superimposed upon the roofs of the 13-inch turrets, in the manner shown in our engraving. By this distribution, not only were the defects of interference overcome, but a more efficient all-round fire was obtained. Though only half the number of 8-inch guns and turrets is employed, the all-round fire from this caliber is better than is possible in the earlier battleships; for on the broadside it is the same, and dead-ahead fire is now possible without interference with the 13-inch gun positions. The 8-inch turrets have been changed from the original designs so as to enable them to be trained independently of the 13-inch turrets—a most important modification.

As regards the rest of the armament, the principal change is the substitution of a secondary battery of fourteen 5-inch rapid-fire guns in place of the four 6-inch guns of the "Oregon" or the six 4-inch guns of the "Iowa." So large a battery calls for a large supply of ammunition and a wide area of armor protection, but the throwing out of four 8-inch guns and two turrets placed a large amount of weight at the naval architect's disposal, which he was able to use advantageously in a powerful secondary battery. The great rapidity of fire in the 5-inch battery greatly outweighs the heavier weight of the 8-inch guns which it in part displaces. In sixty minutes' fighting one broadside of seven 5-inch guns could fire fifty-six shells weighing in the aggregate nearly 3,000 pounds at a velocity of 2,300 feet per second, the total energy of which would be equal to 102,704 foot-tons, sufficient to lift the ship itself 9 feet bodily into the air. The accompanying table shows the broadside discharge:

BROADSIDE DISCHARGE OF THE "KEARSARGE."

Number of Guns.	Diameter in Inches.	Weight in Pounds.	Velocity in Foot-Seconds.	Energy in Foot-Tons.	Total Energy.	Penetration in Inches at Muzzle.	Point of Attack in Enemy.
4	13	1,100	2,100	33,627	134,508	34·6	Belt and main turrets.
4	8	250	2,150	8,011	32,044	21·6	Conning tower and casement armor.
7	5	50	2,300	1,834	12,838	13·0	Thin armor, superstructure, and unarmored ends.

These two fine ships were constructed at the extensive shipyard of the Newport News Shipbuilding Company. They are identical in all respects, having been built from the same set of drawings and specifications. The "Kearsarge" is named after the famous wooden steam frigate (shown in the smaller view on the front page) which met and sank the "Alabama" off Cherbourg toward the close of the Civil War.

The principal dimensions of the new ship are as follows: Length, 368 feet; beam, 72 feet 2½ inches; mean draught, 23 feet 6 inches; displacement, 11,525 tons. The protection at the waterline will consist of a belt of Harveyized steel, which tapers amidships from 16½ inches at its upper edge to 9½ inches at its bottom edge. It is 7½ feet deep, 3 feet being above and 4½ feet below the waterline. This belt maintains its full thickness, as given, throughout the wake of the engine and boiler space and tapers gradually to 4 inches at the bow. Astern, it reaches to a point aft of the after barbette. Above this belt is a flat deck 2¾ inches in thickness, which extends over the engine and boiler spaces. It is continued forward to the bow and aft to the stern in a curved or turtle-back form. Above the armored deck the sides are protected by 5½ inches of Harveyized steel to the level of the main deck, and this armor is also continued to the level of the superstructure throughout the whole length of the central citadel. There are heavy armored bulkheads extending athwartships from side to side, which inclose the bases of the barbettes. The secondary battery within the citadel is also protected by 5½-inch transverse bulkheads. The 6-pounder battery of twenty guns is disposed eight on the berth deck and twelve on the superstructure deck, while the six 1-pounder guns are placed in the military tops. The vessels each carry four torpedo tubes.

Taken altogether, the "Kearsarge" and her mate will form a very powerful addition to the United States navy. Of course their speed seems slow when it is remembered that some foreign navies are building ships of nineteen and twenty knots speed, but this defect is, perhaps, somewhat compensated for by the powerful armor and armament which characterize these two vessels.

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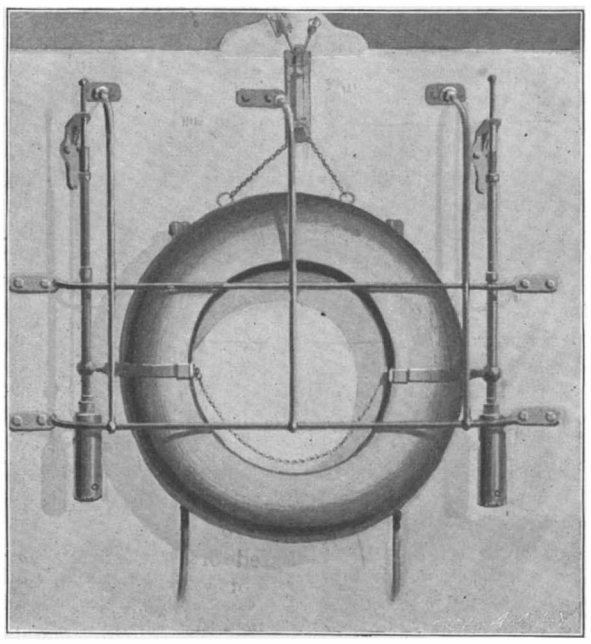
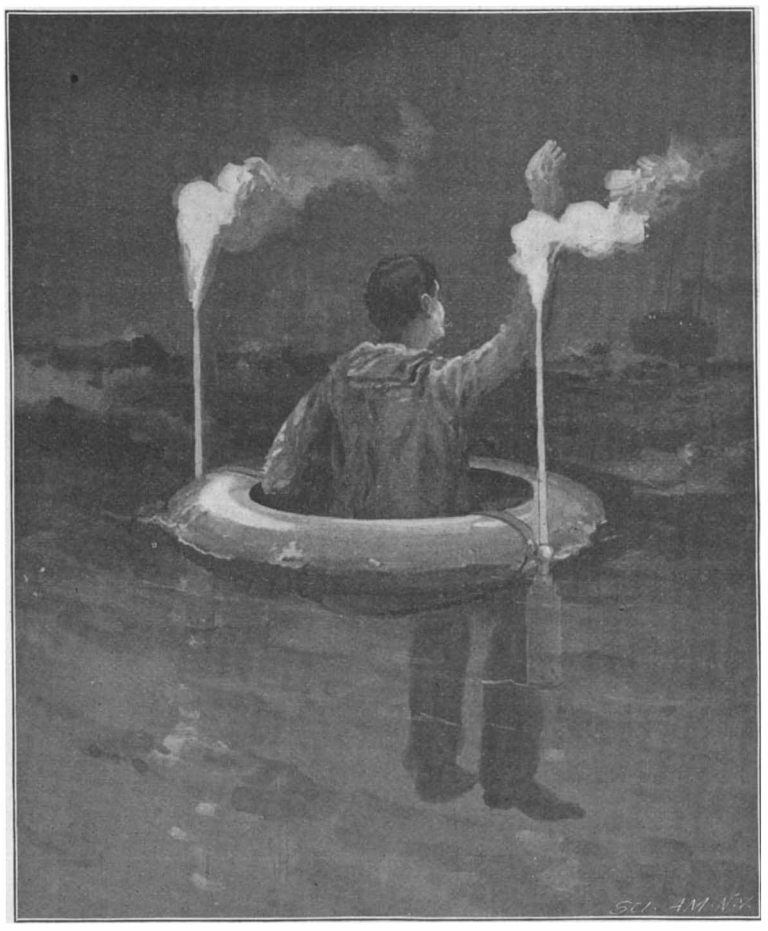
LIFE BUOY DESIGNED BY REAR-ADMIRAL HICHBORN.

The Franklin life buoy, a unique invention of Rear-Admiral Hichborn, is now in use, not only on all vessels of the United States navy, but also to a great extent on the vessels of all considerable naval powers. Like all other useful inventions, it is simple in principle, being a hollow air-tight, metallic ring, provided with two automatic torches which make it possible to locate the buoy at night. The torch staffs are so pivoted to the ring that they will lie in the same plane and stow neatly against the side of the ship as shown in the smaller illustration when the buoy is not in use; but when it is dropped, they assume, by virtue of the weight of their lower ends, a vertical position in the water, thus raising the signals above the surface. Each torch staff is fitted with a chamber at the lower end containing calcium phosphide, a chemical which ignites by contact with the water. When the buoy is dropped, the seals of these chambers are broken automatically, and admission of water permitted, and the gases of combustion ascend and produce a large flare at the top, the combustion being so regulated that there is no danger of over-heating. The flotation of the buoy is sufficient to sustain three men, the central space accommodating one in a sitting position, supported by a chain which crosses the opening, as shown in the second illustration. Generally two of these buoys are hung near the stern, where they can be most easily dropped entirely clear. The most striking test of their efficiency in our service occurred on the ill-fated "Maine," about a year before she was blown up in Havana Harbor. On the morning of February 6, 1897, in latitude 34° north and longitude 75° 42′ west, a position a little south of Cape Hatteras, the "Maine" was breasting a terrific storm, such as would have tried the seaworthiness of the staunchest ship. In executing an order, Gunner's Mate Chas. Hassel and Seaman Kogel were washed overboard. The two buoys were immediately dropped, and Hassel was seen to reach one of them, but Kogel seems to have been stunned, for he made no apparent effort to save himself. Seeing this, Landsman Wm. J. Creelman jumped overboard, and made a futile attempt to rescue him, and after failing succeeded in reaching the same buoy to which Hassel already clung. In the meanwhile, the port life-boat manned by a volunteer crew under command of Cadet Walter Gheradi was lowered, but it was soon found that in the terrific sea, it was quite impossible to reach the imperiled men with the boat, and the crew were hauled aboard by life lines, the boat being abandoned. By this time the two men on the buoy had been lost sight of; but their bearings had been kept, and when the ship steamed in their direction, the torches were soon sighted through the blinding mist of rain, and by the most skillful handling the two men were safely hauled over the bow and landed on deck, so little injured by their adventure that both returned to duty the next day, one of them, Hassel, only to perish in the terrible catastrophe of the following year. Creelman is now a gunner's mate on the "Iowa."



THE LIFE BUOY SUSPENDED FROM SIDE OF SHIP.



FRANKLIN LIFE BUOY IN OPERATION AT NIGHT.

An Alaska Geyser Region.

BY E. HAZARD WELLS.

A remarkable geyser region exists in Alaska near the head of the Copper River, according to the statement of Capt. W. R. Abercrombie, United States army, who spent last summer in that locality conducting government explorations. The Captain was recently in Seattle outfitting for another expedition to the Copper River and furnished the writer with the following statement:

"The geysers lie between Mt. Sanford and Mt. Wrangell, near the head of the Copper River. Great puffs of steam shoot into the air from a point about midway between the two peaks. When I stood upon one of the foothills of Mt. Sanford last August, I could see the steam blown upward from many points with great energy. The country was frightfully broken and it was impossible to distinguish the spots from which the jets arose. I feel certain, however, that there are giant geysers at work there, as the jets had the typical pulsation of the geysers of the Yellowstone. I believe that those of the Mt. Wrangell district are much the largest of any on the continent, judging from the quantity of steam thrown out.

"As I looked off over the forty mile gap between Mt. Sanford and Mt. Wrangell, a marvelous sight met my eyes. Mountains jagged and angular thrust their needle-like points upward in all directions out of masses of ice and lava. Not a vestige of forest or green vegetation could be seen. It was the wildest, weirdest sight that I ever beheld. In the distance loomed the imposing circular cone of Mt. Wrangell, with clear-cut, even-rimmed crater. There was no fire nor smoke to be seen. On the contrary, the mountain appeared silent and cold. I know that it has been the popular supposition that Mt. Wrangell is an active volcano, but I believe that to be a mistake. The geysers that lie between Wrangell and the Copper River have given rise to the error. The steam from them rises in a direct line between Copper Center, on the Copper River, and Mt. Wrangell, producing the ocular illusion that the crater itself is throwing out steam.

"It is my belief that no human being could cross the tempest-tossed region lying between Mt. Sanford and Mt. Wrangell, with its frightful chasms, broken lava beds and glaciers. No man to my knowledge has ever reached Mt. Wrangell, although some thirty prospectors had penetrated to Mt. Sanford when the government party of which I had charge reached the spot last summer. I do not believe that there is any way to get to Mt. Wrangell except possibly from the north near the extreme head of Copper River. Men must carry in supplies or starve. The country will not yield game, except an occasional bear or mountain sheep. There are some enormous bears in the immediate vicinity of Mt. Sanford, which resemble the noted St. Elias grizzlies.

"One that I encountered had black fur with silver tips, a brownish face, and weighed fully 1,800 or 2,000 pounds. He was a monster in every sense of the word. When fired at, he ran off through a canyon.

"The immense lava beds which lie to the northwest of Mt. Wrangell present a strange appearance. The stuff is dark colored and apparently granitic and is tossed about in great chunks and slabs, some of them as large as houses. The lava gradually disappears under an ice cap as it approaches Mt. Wrangell, from which it evidently was thrown out. It would be an impossibility for any one to cross the lava beds.

"One thing that struck me forcibly was the large amount of mineral-bearing quartz cropping out around Mt. Sanford, and, in fact, throughout the entire upper Copper River country. Up to the time that I left there last fall, little genuine prospecting had been done by miners, owing to the difficulty of getting in supplies. Men had to carry their stuff upon their backs. After I have cut through the military road this year, things will be different. I believe that the Copper River runs through a rich mineral belt.

"There are five large mountains in a group near the head of the Copper. They are Mt. Sanford, Mt. Drum, Mt. Tillman, Mt. Wrangell and Mt. Blackburn. These range in height from 12,000 feet upward. No exact measurements have ever been made. I do not know whether Mt. Wrangell is higher or lower than Mt. St. Elias, but it is certainly much higher than any other peak in central Alaska, with the exception of Mt. McKinley.

"So far no prospecting has been done upon the upper Tanana River, near where it approaches the Copper. No boats succeeded last summer in ascending the Tanana, which is one of the largest tributaries of the Yukon. I was not able to judge of the mineral possibilities of the Tanana, not having investigated the stream very far. I do know, however, that the upper Tanana runs through what is at present the best game country in Alaska. There are thousands of moose and caribou there.

"My work this year will not be so much of an exploratory nature as it was last year, but I expect to secure considerable new data, which will be utilized, in all probability, in the published report of explorations in Alaska, which the War Department expects to issue soon after Congress grants an order passing it to print."

Mt. Wrangell is one of the most interesting features of the North American continent. It lies in a region difficult of exploration and enshrouded in mystery. The Alaskan natives have some superstition connected with the "big mountain," and refuse to go near it. In 1890 I endeavored with three assistants to force a passage across Alaska from Forty Mile Creek to Mt. Wrangell, by way of the Tanana River, and tried in vain to secure native guides at several villages. Offers of guns and ammunition were made without avail. I was told that no man could go to the mountain and live. Pushing ahead, without guides, we ascended the Tokio River, then unmapped, and proceeded toward Mt. Wrangell, crossing a tempest-tossed country, which became more and more forbidding as we advanced. It seemed as though primeval nature, gathering together all of her gigantic energies, had there endeavored to upheave an apex to the North American continent. Our provisions finally gave out, and we only escaped starvation by eating our one dog and roots which were found at various places. We managed to get back to the Tanana, and descended that river to the Yukon. So far as I know, this was the first and only attempt ever made by an exploring party to reach Mt. Wrangell. It can be seen from a great distance, owing to its extreme height, and up to the present time has always been classed among active volcanoes, owing to the ribbons of steam or smoke which have been discerned rising apparently from its crater. Capt. Abercrombie, however, has had superior opportunities for observation, and his declaration that giant geysers exist would account for the observed phenomenon and also for the superstitious fear of the natives in regard to this particular mountain, which makes them unwilling to approach it.

Active volcanoes exist in Alaska and volcanic phenomena are not unfamiliar to the people there, but geysers are not known to exist in any other region than around Mt. Wrangell.

Liquefying Hydrogen.

It is now over twenty years since Raoul Pictet, of Geneva, announced the results of experiments carried on with the object of liquefying that most refractory of all the so-called permanent gases, hydrogen, but up to a week or two ago all efforts in this direction were, at the best, problematical and unconvincing. Now, however, a grand achievement has been effected by Prof. Dewar and his able assistant, Mr. Robert Lennox. These investigators, by the undoubted liquefaction of hydrogen, have put the finishing stroke on the line of research initiated by Faraday when he first reduced the gas chlorine to a liquid. The new agent of scientific research, liquid hydrogen, congeals the air surrounding the containing tube into a snow-like solid, and a piece of cork sinks to the bottom when put in the liquid; the temperature at the boiling point is 21° absolute, or —252°, a temperature representing a pressure which is immeasurable. The liquefaction of hydrogen is a triumph of theory as well as practice, for in face of all the enormous difficulties which have been encountered, theorists have never deviated one jot from the conviction, which sound reasoning long ago showed, that there is no such thing as a permanent gas.—Knowledge.

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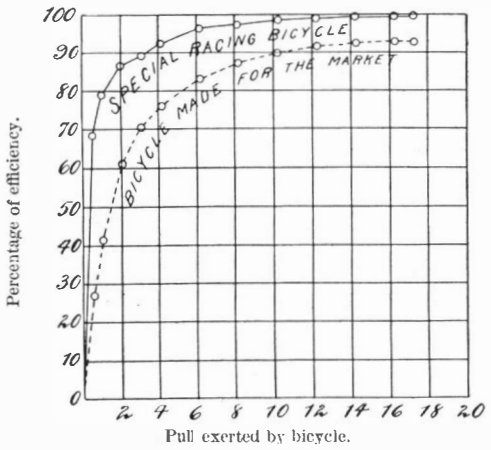
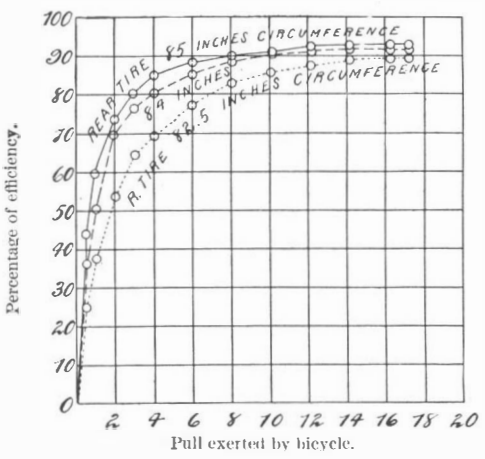
A MILE IN LESS THAN A MINUTE ON A BICYCLE.

As our readers are aware, it is not the custom of the SCIENTIFIC AMERICAN to lend its columns to the announcement or discussion of feats of speed or endurance, and it is only when such performances have a distinctly scientific bearing that an exception is made. The remarkable ride recently accomplished by the bicyclist C. W. Murphy, however, who covered a mile in 57⅘ seconds, has such an important bearing upon the question of air resistance, while the distance and time were surveyed and recorded by such unimpeachable authorities, that the facts are well worthy of being carefully recorded, both for their scientific value, and as data for future reference.



TEST OF COMMON AND RACING BICYCLES.

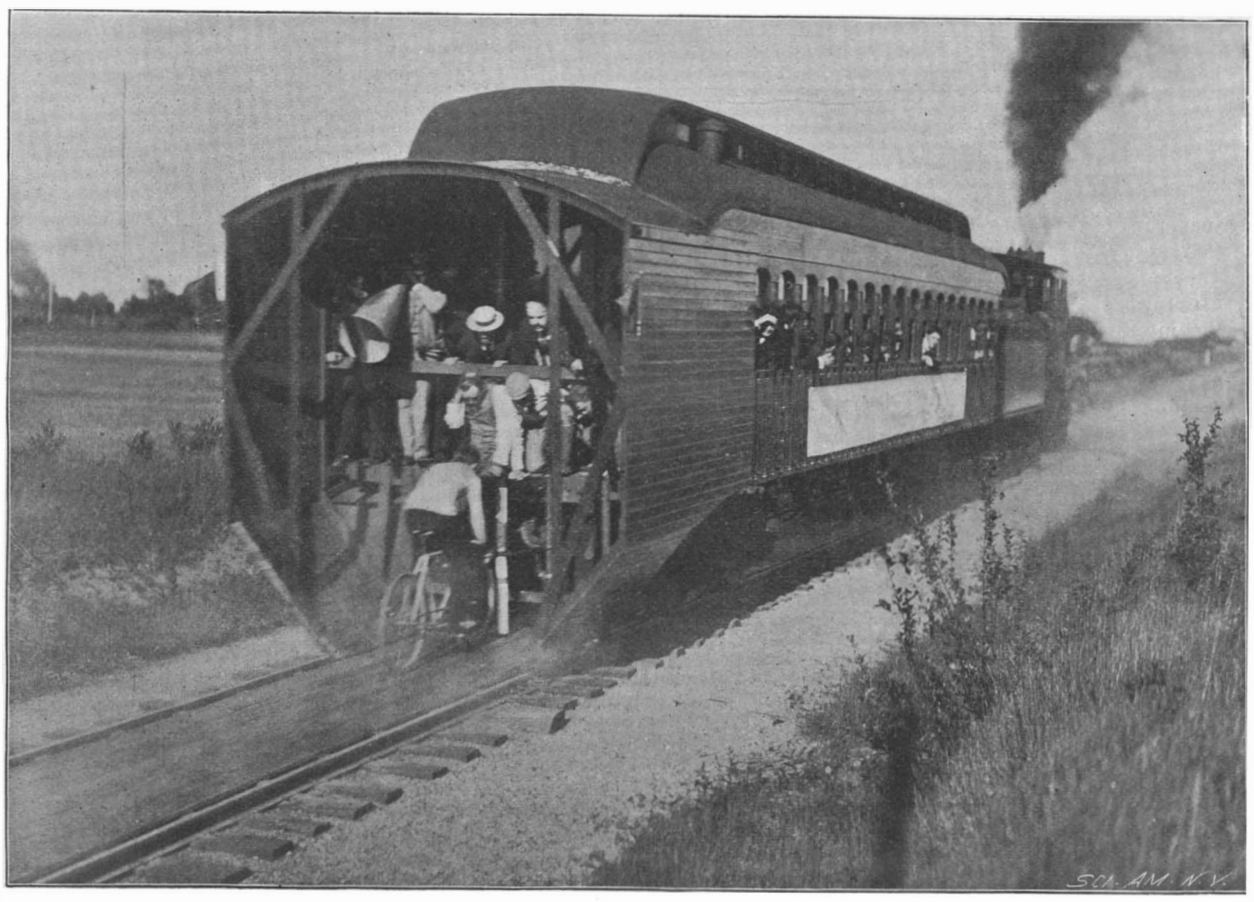


TEST OF EFFECT OF PARTIALLY DEFLATED TIRE.

The Long Island Railroad, at the request of Mr. H. B. Fullerton, who is the special agent of the road and holds the position of vice-consul of the League of American Wheelmen, arranged to give Murphy an opportunity to ride a mile, paced by a locomotive, on a five-mile stretch of local track which is used only on special occasions for the transfer of trains between the two main branches of their system. Murphy, who is a well-known cyclist, has for many years been anxious to prove that if fast enough pace could be secured, a mile could be ridden within 60 seconds. His remarkable and, as the event proved, successful attempt was arranged by the railroad company as one of the attractive features of the State meet of the League of American Wheelmen, which took place a few miles further up the road, at Patchogue, Long Island, the railroad company running special trains to the scene of the trial course.

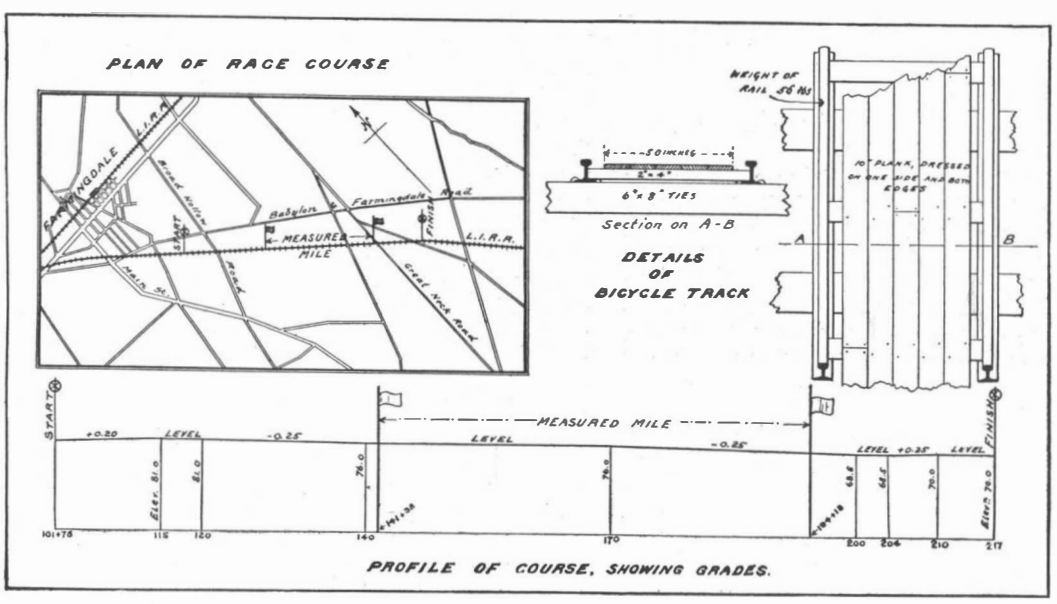
The accompanying plan and profile furnished us by the chief engineer of the railroad show the location and grades of the course. The measured mile was laid off on a straight and approximately level stretch of road about 2¼ miles in length. Three-quarters of a mile was allowed on which to get up speed and half a mile on which to slow up. The bicycle track was supported on 2 by 4-inch ties, which were cut to exact length and laid on the inner flanges of the rails. Upon these were laid five 1 by 10-inch planks, which were dressed on both edges and the upper side, and laid close together, the abutting ends being arranged to break joint on the ties. The railroad track and roadbed were of the light construction used 20 to 25 years ago, consisting of 56 pound rail laid on 6 by 8-inch ties, upon a sand and gravel ballast. The Long Island main lines are laid with 80 and 90-pound steel; but the infrequent use of the track on which the trial took place, and the slow speed at which the few trains that use it are switched from one main line to the other, does not necessitate any heavier construction. The bicycle track, of course, extended the whole 2¼ miles of the course. The mile was measured with an engineer's steel tape under the personal supervision of Mr. P. D. Ford, the chief engineer of the Long Island system, and was personally remeasured just before the race by Mr. James E. Sullivan, secretary of the Amateur Athletic Union, who acted as the referee of the trial.

The pacing outfit consisted of an engine and one passenger car, at the rear of which had been constructed a wind shield of the kind shown in the accompanying illustrations. And just here, before we describe the construction of the shield, it will be as well to state that at one time, in the preliminary preparations, it began to be a question as to whether the locomotive itself could, on so short a track, develop and hold a speed of a mile a minute. To start from rest and get up to a speed of a mile a minute in three-quarters of a mile is no easy task, even when the load consists of only one car, especially when, as in this particular instance, the first 1,500 feet of the track is on an up grade of 10½ feet to the mile. Altogether six trials were made with three different engines. The first three were made with No. 34, one of the older engines, with 17 by 24-inch cylinders, and the results were not encouraging. The first run over the mile was made in 68 seconds, the second in 67, and the third in 62 seconds, while the steam fell from 140 to 80 and 90 pounds. Another 17 by 24 engine was tried, with the result that the steam fell from 140 to 100 pounds, the time of the trials being 68 seconds for the first and 65 seconds for second run. On the last named trial Murphy was behind the shield and held the pace very comfortably. It was then decided to use a more powerful engine with larger boiler capacity, and No. 74, with 18 by 24-inch cylinders, was given a trial. This is an 8-wheel engine of the American type, with 68-inch drivers and large firebox and heating surface. The weight on each pair of drivers is 35,000 pounds, and the total weight of engine and tender 91 tons. On the first trial No. 74 covered the mile in 56 seconds, the steam falling from 180 to 170 pounds, and Sam Booth, the engineer, was satisfied that he could take the bicyclist over the course at the speed requested, which was 58 or 59 seconds, or just within the minute.

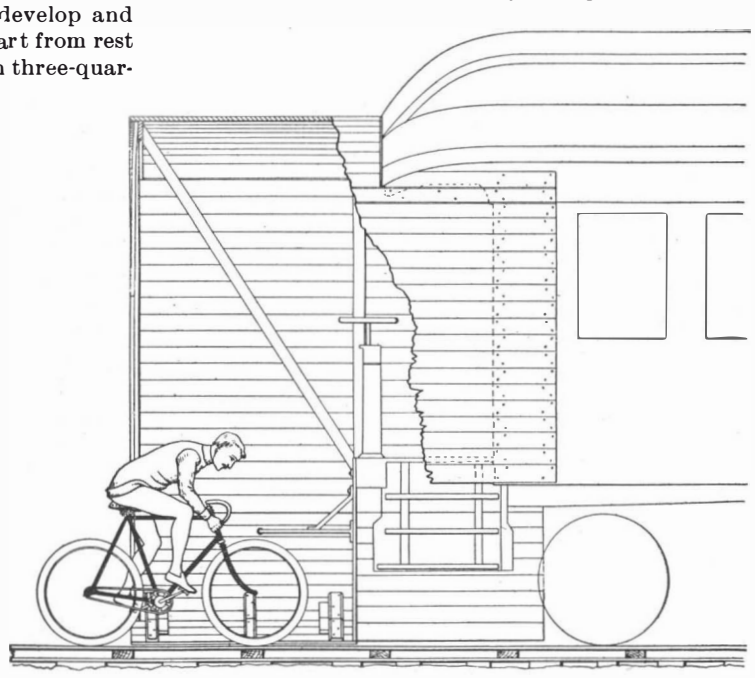


SNAPSHOT OF C. W. MURPHY DURING HIS RIDE OF ONE MILE IN 57 4-5 SECONDS.

The shield was built of 1 by 3-inch tongued and grooved sheathing, laid over a light framework of 2 by 4 scantling. It was built flush with the sides and roof of the car and extended for a distance of 5 feet beyond the rear of the platform. Below the level of the floor of the car platform its sides sloped inwardly until its bottom edges were between the rails and the board track. Projecting forward below the car platform and extending down to within an inch of the track was a plow-shaped projection which served to deflect the wind, dust, etc., to each side of the shield. The latter was thus perfectly closed at the front, top, and sides, the only entrance for air being by way of the one inch of clearance between the shield and the track. To enable the rider to keep the middle of the track a vertical strip of wood 3 inches in width and painted white was nailed to the rear of the car platform. To prevent his wheel from touching the rear of the shield a fender of 1-inch round iron projected rearwardly 2½ feet at a height which would allow the front wheel of the bicycle to pass beneath it,



PLAN AND PROFILE OF COURSE AND DETAILS OF TRACK.



DETAILS OF WIND SHIELD.

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but would cause the head of the machine to bring up against the bar, which was covered with rubber to lessen the shock.

The beginning and the end of the mile were each marked by large flags, one green and one red, and the quarters were marked by white flags, placed on the right hand side of the track. The timers, five in number, were all men who are well-known judges and timers in the various athletic gatherings in the East. They were stationed at the last five open windows of the car, and can be plainly seen in the snapshot photograph of the ride which is herewith reproduced. They carried split-seconds stop-watches, and each quarter was taken by two timers to avoid error. In the only case where they differed, the referee accepted the slower time.

The rider, who is twenty-eight years old and weighs 154 pounds, was mounted on a Tribune racing wheel, which weighed 20½ pounds, had 6½-inch cranks, and was geared to 120. For the trial ride, made in 65 seconds, he had used a 112 gear. On the car were Messrs. W. F. Potter, the general superintendent of the railroad; P. D. Ford, the chief engineer; J. H. Cummin, superintendent of bridges and buildings; H. B. Fullerton, who had charge of the trial, together with representatives of the press, and several engineers, who were interested in the scientific side of the experiment. In pulling the engine up to a mile-a-minute speed, the engineer, with one hand on the throttle and the other on the sand-lever, gave the cylinders all the steam they could use without slipping the drivers, the throttle being pulled gradually open to one-half with a ¾ cut-off. The acceleration was wonderfully rapid, and the first quarter of the mile was made in exactly 15 seconds, the last three-quarters being covered in 14⅖, 14⅖, and 14 seconds, or 57⅘ seconds for the mile. The average speed for the mile was 62·28 miles per hour, and for the last quarter the speed was 64·29 miles per hour.

Murphy kept inside the shield and within a few inches of the iron fender bar until he entered the first quarter, when it was noticed that he kept falling a foot or two back and then running up and striking the head of his wheel against the bar. He finally fell back about fifteen feet, and rode for the rest of the mile entirely outside the shell and just ahead of a perfect maelstrom of dust which whirled and eddied behind the shield. Then, as the mile flag was passed, he sprinted forward and closed up until he struck the fender, when he commenced to climb aboard the car, assisted by those on the platform, the wheel, which was held by the toe-clips, being dragged up with him.

This was certainly the first time that anyone overtook and boarded a train going at a speed of over sixty-four miles an hour.

In the trial ride of a week before, it was arranged for the rider to back-pedal when the mile flag was passed, the engineer at the same time making a final spurt to run clear, thereby allowing the resistance of the air to assist the rider in slowing up. This was done; but, as should have been foreseen, the violent eddies in the air nearly threw Murphy from his wheel, and it was, no doubt, the determination to stay within the shield on the second attempt that prevented a fatal accident.

We are informed by the rider that at no time during the ride was he working up to his full power. All went well until he entered the first quarter, when a violent vertical vibration set up in the track, "as though the boards were rapping the bottom of my wheel." At the same time, although he was riding "in perfectly still or dead air," the effort necessary to drive the wheel varied, the effect being as though he were riding over an undulating instead of a level track. Thinking that the track might be less "lively" further back from the train, he dropped back 15 feet, and here, though a slight wind resistance was felt at his sides, making harder pedaling necessary, the vibration was not nearly so marked. There is no doubt that the vibration and undulating sensation were due to the natural elasticity of a light track under the rapid passage of a 91-ton engine. The rebound of the rail joints after the passage of the train would produce a rapping effect on the plank track, and the "wave-action" of the whole track at such a high speed would easily have a retarding or accelerating effect on anything so light as a bicycle, according as the wave moved to the front or the rear of the rider.

In view of the fact that Murphy assures us he was not riding up to his full power, the question arises as to how fast a bicycle could travel if the proper pace were supplied. Probably on a rock-ballasted track, laid with 100-pound steel, where the vibrations would be greatly reduced, one of the younger racing men who are accustomed to paced riding, or Murphy himself, could cover the mile in 50 or even 45 seconds. Of the three kinds of resistance to bicycle propulsion, the internal friction and the rolling friction, as is shown by the accompanying diagrams of tests carried out by R. H. Fernald, M.E., of the Civil Engineers' Club of Cleveland, O., are very slight in a carefully constructed racing-wheel, with the tires inflated to the full limit; and in the recent trial the most serious resistance, that of the atmosphere, was entirely wanting. Hence, it is possible that Murphy is right when he says that on a perfectly quiet track a bicyclist can follow any pace the locomotive can set for him. It is more a question of rapidity of pedaling, and a cool head, than of strength and endurance. Although he was using a 120 gear, equivalent, as we showed in the special bicycle number of the Scientific American of May 13, to a 10-foot driving wheel covering over 31 feet at each revolution of the pedals, the rider was spinning his feet at the rate of 2·91 revolutions a second or 175 revolutions a minute.

Without disparaging in any degree the persistence and pluck of the bicyclist, the most interesting feature of the ride is the impressive object-lesson it affords as to the serious nature of atmospheric resistance on moving bodies, a question which is discussed at some length in our editorial columns.

Curio Factories.

A well-known curio expert states that there are factories in Europe for the manufacture of all kinds of works of art that are likely to attract the collector. Modern articles of china are stamped with old marks so cleverly that even experts have been deceived. Arms and armor are treated with acids which eat away the metal, thus producing the same effect as the ravages of time. Carved ivories are stained with oils to make them yellow, and are subjected to heat to make them crack. Pieces of furniture have holes drilled to represent the worm holes, and so on, until there will in time be very little in the way of curios which are in themselves really curious. Paris is one of the strongholds of this class of forgers, while in Hungary there is a factory where Dresden china is imitated in a fair manner. There is, however, one safe way, and that is to buy through reputable dealers. Forgeries in all works of art very rarely get into the dealers' hands. As a rule they are sent to auction rooms.

Many amateurs have an idea that they may pick up a priceless work of art or curio for a mere song. That is the chance for the forgers. They know all this and work accordingly, and thus the amateur is deceived. The spurious curio makers haunt out-of-the-way auction rooms, where amateurs look in with the idea that nobody but themselves can know of the room in question. The sale takes place, and they come away with a gem, so they think, and are perfectly happy until undeceived. There has, curiously enough, in this connection, lately been discovered a disease which eats away bronze and gives it a sign of antiquity. All objects of antiquity fabricated from metallic copper and its important alloy, made by adding tin in certain proportions, are liable to be attacked by this destructive corroding affection. Skilled artists of these false antiquities are known to inoculate their reproductions with spots of bronze disease.—Pottery Gazette.

Telephones of the World.

I give below, says Edward D. Winslow, United States Consul-General at Stockholm, writing to the Department of State, statistics in regard to the telephones in use in the different countries of the world, which have been carefully prepared by the statistical department of this government:

Countries.	Number of Instruments in Use.	Distance Covered, Miles.
Sweden (1897)	56,500	74,568
Norway (1897)	20,678	33,481
Denmark (1895)	10,500	9,321
Great Britain and Ireland (1894)	69,645	83,401
Holland	8,000	4,971
Belgium (1895)	9,227	16,235
Germany (1896)	151,101	147,093
Austria (1896)	21,616	46,375
Hungary (1896)	10,293	17,940
Switzerland (1897)	28,846	47,594
France (1894)	27,736	63,230
Italy (1896)	11,991	13,049
Spain	11,038	14,282
Russia	18,495	40,391
Japan	3,232	5,262
Philippines	452	592
Algiers	335	224
Tunis	200	281
United States (1896)	772,627	825,711
Cuba	1,818	1,181
Canada (1898)	33,500	44,020
Mexico (1896)	9,000	11,807
Uruguay (1896)	3,269	8,117
Total, including 9 countries not mentioned..	1,288,163	1,509,499

A Vermiform Appendix Containing a Minute Piece of Bone.

Dr. Charles Phelps reported this case before the Society of Alumni of Bellevue Hospital. He stated, says The New York Medical Journal, that the attack had begun eight days before, but the patient had not come under his observation until three days before the operation. A small abscess had been found and evacuated. A perfectly smooth mass, feeling like a kidney, had been brought into the wound, and had been found to contain the appendix. Within this appendix was a minute piece of bone. The irritation produced by this foreign body had resulted in the production of this mass of inflammatory exudate. Some surgeons, he said, maintained that they had never found a foreign body in their cases of appendicitis; he had found them quite frequently, but this was the most minute one that he had met with.

Dr. Robert T. Morris said that usually the things which were called grape seeds, etc., proved, on searching microscopical and chemical examination, to be ordinary concretions of insoluble salts, mixed, in most cases, with more or less fæcal matter. For this reason one should be careful in determining this point. He had found a piece of apple core in one appendix, and it was the only foreign body that he had discovered in his cases. In one of Dr. Wyeth's cases he had seen some lemon seeds.

Miscellaneous Notes and Receipts.

Alloy White Metal Candlesticks.—Great cheapness of the metal being usually a chief condition, such compositions should be chosen in which zinc plays a chief part, e. g., zinc, 85 parts; tin, 1½ part; antimony, 3 parts; and copper, 10 to 12 parts. An addition of lead renders the alloy more easily fusible and enhances the pliancy, but prevents the formation of fine edges in the molds. Too large an admixture of copper gives the metal a yellow color. An addition of tin, even in a larger proportion than given above, is of advantage for the composition. Nickel, aluminum and bismuth are also used in large or small quantities, for the production of white metals, and frequently arsenic is added.—Dampf.

Clearing-Vat Bottoms of Bronze.—Instead of copper, Brewmaster Rüffer recommends the use of bronze as a material for the perforated bottoms in the clearing vats. As a matter of fact various essential advantages can be quoted in favor of bronze.

It is obvious that a clearing bottom will do the work so much quicker and increase the yield according to the number of holes in it. In a bronze bottom 6,700 holes per square foot may be cut, which number it is hoped to increase to 10,000, while a copper bottom can only receive 4,500 holes per square foot at most. The copper bottoms present another drawback in that they are readily scratched and bent, because copper is comparatively soft. Besides, copper oxidizes quickly, and is readily attacked by acids, for which reason it must be frequently subjected to a careful and thorough cleaning.

All these evils are precluded with the use of bronze bottoms. The metal is hard, resistive, oxidizes little and is easily kept clean and bright, features enough to give bronze bottoms the preference.—Wochenschrift für Brauerei.

Composition for Preserving Furniture.—By V. H. Soxhlet. Take small pieces of wax, white or yellow, and add oil of turpentine until the solution has the consistency of a thick paste. Of this mixture lay a piece as large as a bean upon a piece of cloth and rub it out as much as possible on the piece of furniture. Then wipe with a woolen rag.

By this process the gloss is restored to walnut furniture, to marble, to varnished metal, etc. But if this composition is to be used on articles which have a red color, the oil of turpentine must be colored before adding the wax, by soaking some alkanet in it, until the oil turns a deep violet. If the gloss is to be restored to mahogany, the oil must be dyed only slightly, because this wood has a tendency to become brown in time; bird cherry wood, however, bleaches in the course of time, hence for this the oil must be strongly colored.

It is well to use of this mixture only a piece of the size of a bean at a time. If more is taken, it is necessary to rub a longer time. Hence, it is better to put on a second thin layer and to repeat the operation several times. This requires more time, but is less tiring and gives a better gloss. After rubbing with the woolen rag, it is well to finish rubbing with an old linen one.—Neueste Erfindungen und Erfahrungen.

Preparation of Oil Copal Varnish.—By V. H. Soxhlet. This is prepared by melting coarsely crushed copal, 240 grammes; purified oil of turpentine, 260 grammes; readily drying linseed oil varnish, 360 grammes. The copal is placed in a glazed earthen pot of sufficient size and well moistened with oil of turpentine. The pot is then closed with a lid, placed on glowing coal and left there about ¼ hour until the copal is melted. When melting commences, stir with an iron rod until the copal has dissolved completely. Now add boiling hot linseed oil varnish, slowly and with constant stirring, the coal fire being increased, so as to cause the mixture to bubble up a few more times, whereupon the pot is removed from the fire to cool off, and the warmed oil of turpentine kept in readiness is added.

The varnish produced in this manner is sifted through oakum, into a dry, previously warmed vessel. Before applying the varnish, the wooden articles are coated with weak glue water (size) or with linseed oil varnish, and when the ground has dried perfectly the varnish is put on uniformly with a good brush. As a rule, one coat of this varnish suffices, but if a second one becomes necessary, it should only be applied when the first one is completely dry. Later on the dry varnish is smoothed and rubbed down. The fusing of the copal may also be carried out in a glass flask surrounded with wire work. Hang the flask over a gas flame and keep it in constant motion until the copal has melted.—Neueste Erfindungen und Erfahrungen.

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UNIVERSAL AUTOMATIC SCREW MACHINE.

The reputation of American manufacturers throughout the world for making machines with interchangeable parts has been won by the use of machinery of the class illustrated; but the machine here shown is in many respects a great improvement over those formerly used.

This machine can be changed to adapt it to any class of work by the aid of auxiliary parts which may be readily attached or removed. It was designed by Mr. Lavigne, of the Lavigne Automatic Machine Company, of New Haven, Conn., and is intended to avoid the necessity of building a number of styles of machines each adapted to only one class of work, and to render it really universal in its application.

The frame of the machine is arranged to receive the various parts, shaft, cam disk, cam drums, worm gear, and differential gear, all of which are so located as to make them accessible, and permit the attachment of auxiliary parts without disarranging other parts of the machine.

Extending through the center of the machine is a splined shaft, to the extreme ends of which are keyed two large drums, provided upon their peripheries with a number of cams, designed to engage anti-friction rolls on the studs which impart movement to various parts of the mechanism.

This screw machine is provided with the usual hollow arbor and revolving turret carrying the various tools. It is also provided with mechanism for rotating the turret to bring the different tools into action at the proper time.

The turret is rotated positively, and securely locked each time it is moved to a new position and at the same time it is locked down, thus causing the tool to make a smooth cut, which it could not do if the turret were allowed to move or vibrate while a cut is being taken. All this is accomplished without the use of springs of any kind. Where the number of tools used is less than the number of holes in the turret, the latter may be revolved to the tool required without the necessity of moving the turret forward; this is accomplished by a star gear and a series of pins and cams on the periphery of the turret drum. This arrangement saves time and wear and facilitates getting out work.

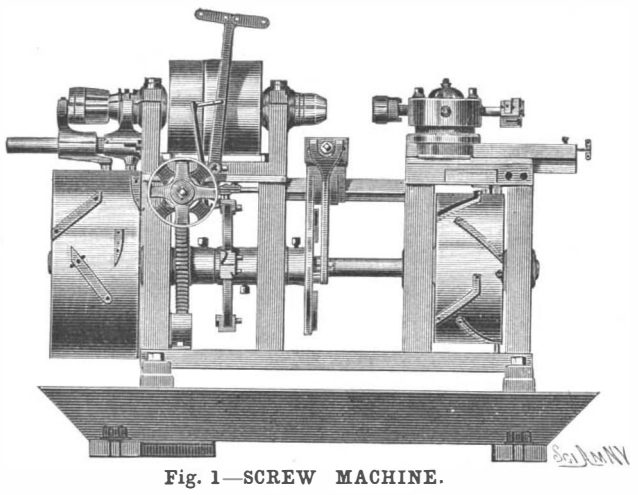

Fig. 1—SCREW MACHINE.

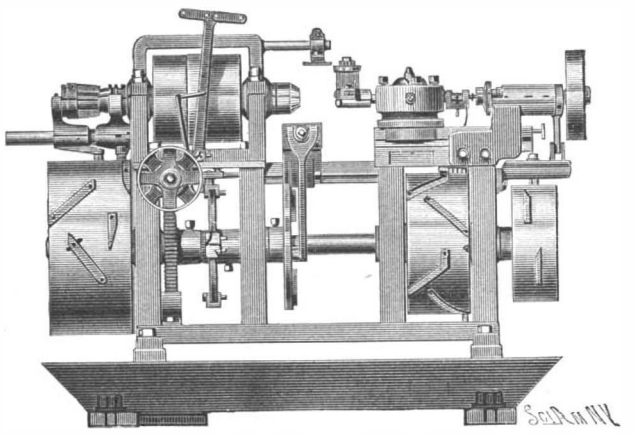

Fig. 2—SCREW MACHINE WITH REAR ATTACHMENT.

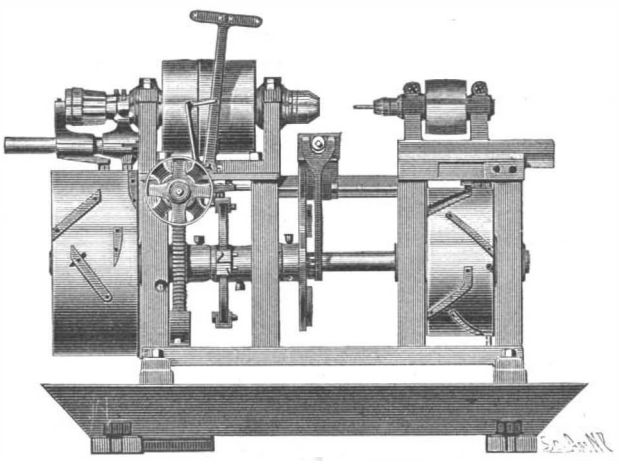

Fig. 3—STUD MACHINE WITH DRILLING ATTACHMENT.

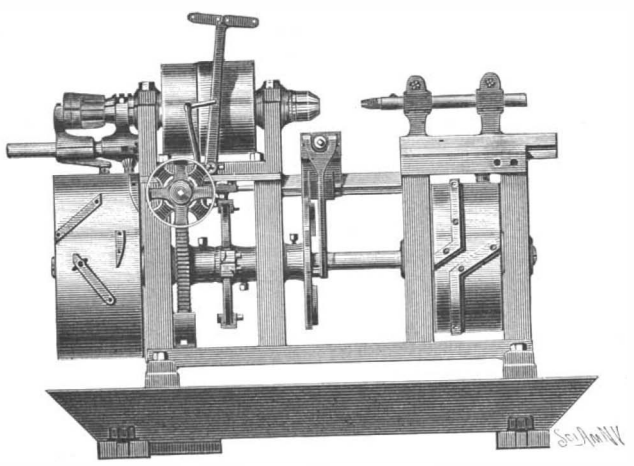

Fig. 4—STUD MACHINE

The turret is provided with from four to six holes, according to the number of turret tools required to produce the work. The turret on the extreme rear motion of the slides is released, and automatically on its forward motion it is clamped downward to the slide, at the same time locked by a ring locking bar, extending the full length of the slide. This bar has long bearings, and is provided with take-up gibs operated by screws for taking up wear and for realinement of the turret with the spindles.

The differential gear mechanism gives speed from 1 to 35, and is constructed so that it may be taken apart without disturbing the other parts of the mechanism.

The cross carriage or cut-off carriage is set on a movable holder, which may be set to any distance from the head and there rigidly secured.

The cross slide is furnished with two tool posts. An auxiliary turret attachment can be applied to the cross slide so as to allow of the use of one or more tools as may be required by the work being done.

A micrometer applied to the cross slide permits of taking up the wear on the tools or of adjustment to compensate for any variation in the setting of the cross-slide cams.

The tool posts receive forming and cutting off tools which can be ground on the cutting surfaces until they are entirely used up without changing their shape, thus enabling the machine to produce work of uniform size until the tools are discarded.

The cross slide and cross-slide holder may be moved toward the tail end of the machine, so as to leave ample space to remove the chuck and spring collets, and may be returned to its former position without disturbing the tools or the setting of the tools on the cross slide.

A lever attached to the closing cam, on the rear end of the spindle, operates the releasing and lightening on the stock, and will indicate to the operator by grasping same the tension that is brought to bear on the finger which embraces the stock.

The cam disk operates the shipping levers on both the differential gear and the spindle. This disk being located directly under the spindle and differential, makes it convenient for setting the machine for close work.

For long or heavy cuts, demanding a taper where side-forming tools are impracticable, a simple attachment is furnished for advantageously accomplishing the desired result. A single-point over-shot box tool is directly connected with a small horizontal gear wheel. This latter on the advance of the turret engages with racks arranged on either side of the gear wheel, as the nature of the work may require. The gear wheel revolves on these racks in either direction, and the cutting tool in turn is either raised or lowered as it advances on the work. Straight turning may be done at any point of the operation by omitting the proper teeth on the racks. On the return of the turret the gear wheel necessarily reverses the motion of the advance, and the cutting tool returns to its original position. By entirely omitting the racks, a straight cut will be obtained. But one box tool of this kind is necessary for each machine, and is universal in its use.

Furthermore, when regular straight work is required, the racks are removed from the overhanging arm and the circular graduated index plate on the top of the box tool can be set to the one-thousandth of an inch, thereby obtaining any size desired. Remarkable results in both straight and taper work are obtained in this way.

Where it is necessary to finish both ends of a piece, the rear end attachment is used. The piece, on being cut off, is retained in a holder and carried with the turret. When opposite its original position, it engages with the rear end attachment, and is threaded, drilled, or slotted, as may be required. This does not interfere with the original operations, which are going on independently at the same time with it. When this attachment is not required, it can be detached from the machine.

Each machine is provided with a rotary oil pump, which is directly connected with the differential gear shaft, and insures a sufficient supply of oil to the tools when in operation.

Countershaft for each machine has self-oiling boxes, three-step cone differential gear pulley, and necessary pulley for spindle. The step-cone pulley has friction clutch and self-oiling boxes.

These machines are applicable to a great variety of work, and are not limited to the production of finished pieces from the bar. Blanks of any description can be fed and machined with the aid of a magazine feed attachment. One operator can run from five to ten machines according to the character of the work.

In the accompanying cuts, Fig. 1 is a regular screw machine for producing plain screws, which require operations only on one end; Fig. 2, screw machine with rear end attachment, for producing work requiring operations on both ends; Fig. 3, roll machine, for producing work requiring a hole in the center with various formed shoulders on the outside, or plain if required. The pulley on the back slide is added to give increased production, and more accuracy to the drill than could be obtained with a stationary drill; Fig. 4, plain stud machine, which is especially adapted for making studs or pieces which require only cutting off to length, or with various shoulders on the periphery of the stock.

The Lavigne universal automatic screw machine was invented and introduced by the Lavigne & Scott Manufacturing Company, about two years ago, and these machines met with such success that it became necessary that the facilities for manufacturing machines should be greatly enlarged. The result was the founding of the Lavigne Automatic Manufacturing Company as successors to the Lavigne & Scott Manufacturing Company.

They make machines of 15 different sizes, of which the smallest has a capacity of $\frac{3}{16}$ inch, and the largest 4 inches. The weights of the machines range from 485 pounds to 5,650 pounds. All parts are made by special gages and are interchangeable.

Putty for Parquet Floors.

In reply to a question on this subject, The Painters' Magazine offers the following: The recipe for putty referred to is a thorough mixture of paper, preferably blotting paper, which has been soaked in boiling hot water until pulp is formed, which is then mixed with glue, also dissolved in water. To this bolted whiting is added in sufficient quantity to make a fairly stiff putty by kneading the mass, which is pressed into the cracks and smoothed off with the spatula or putty knife. However, this putty is recommended for large cracks only, because unshrinkable, but is scarcely adapted for shallow cracks in a parquet floor. For this purpose we would recommend 1 part white lead in oil, mixed with 2 or 3 parts of bolted whiting and enough coach varnish to make a stiff paste. If the work must be hastened, coach japan may be substituted for part of the coach varnish. This putty will resist moisture, and when dry and hard may be sandpapered or rubbed, and it may be tinted with color, if required to match the color of the wood.

The Current Supplement.

The current SUPPLEMENT, No. 1228, contains many articles of great interest. "Greek Architecture—The Lighting of Temples" is one of Prof. Aitchison's interesting Royal Academy lectures. "Geodetic Operations in the United States" describes the important work carried on by the survey. "Mammoth Ivory" is an article by R. Lydekker. "The Grand Cañon of the Colorado" is by Prof. Ralph S. Tarr, of Cornell. The usual notes and consular matter are published.

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RECENTLY PATENTED INVENTIONS.

Bicycle-Appliances.

BRAKE. — JOSEPH F. A. FARFAN, Port-of-Spain, Trinidad. This bicycle-brake has a brake-shoe carried by the fork of the steering-head and arranged to engage the tire or rim of the wheel. The brake-shoe is operated by a lever on the steering-handle, which lever is flexibly connected with the brake-shoe.

Engineering Improvements.

ROTARY ENGINE.—MARTIN A. GREEN, Philadelphia, Penn. The engine is inclosed in a casing having an internal chamber provided with tangentially-discharging feed-ports. In the chamber a turbine-piston rotates, having a series of peripheral pockets terminating in lateral escape-grooves. A valve is fixedly held in the end of the internal chamber and is fitted with exhausts, portions of which are adapted to receive the direct impact force of the exhaust from the piston escape-grooves, before the exhausts from the piston communicate with the exhausts in the valve. The piston thus receives a supplemental forward thrust independent of the live steam-pressure entering against the piston.

ROTARY ENGINE.—WILLIAM S. TICHENOR and JAMES F. WILLIAMS, Owensville, Ind. Through the cylinder of the engine a main shaft is extended on which two pistons are mounted. One piston is rigidly connected with the shaft, the other is longitudinally movable of the shaft. Each piston is provided at its outer face with an annular channel. In each channel an abutment is located. Abutment-blades are movable into the channels and also into recesses formed in offsets of the cylinder. Cam-wheels carried by the shaft move the abutment-blades outwardly, means being provided for moving the abutment-blades inwardly, and means for controlling the admission and exhaust of steam.

Mechanical Devices.

MACHINE FOR PITHING STALKS.—GEORGE R. SHERWOOD, Kearney, Neb. This invention is an improvement in machines for separating the pith and the shell or casing of pith-bearing stalks. In the present machine means are provided whereby the shell is removed from the opposite side of the stalk, so that the intermediate pith-portion may be discharged after the shell or casing is removed. In this operation the shell is removed from the opposite sides of the stalk, so the pith, as it passes from the first to the second cutter, will be supported by the shell on one side of the stalk.

GRAIN-LOADING MACHINE.—JOHN E. COWLES and CHARLES W. ANDRIDGE, Storm Lake, Iowa. This apparatus is adapted to be connected with a grain-elevator and to be arranged partly within and partly without the car to be loaded, and to be operated in such a manner as to discharge into either end of the car, the grain descending through the elevator spout. The apparatus comprises a fan-casing, a fan, a rotary shaft having a pulley on its outer end, and a rigid bar adapted to be held and adjusted between the guides. The direction of the rotation of the shaft and fan determines which end of the car shall receive the grain.

MECHANICAL MOVEMENT.—OTTO WEISE, Aschersleben, Germany. The invention relates to that class of mechanism used in putting bench and vise screws into and out of action. The screwed spindle is mounted in a bush in which it slides longitudinally, but upon rotation carries the bush around, owing to a keyway-and-feather connection between the two. One collar of the bush is so formed with a pawl-shaped tooth that rotation in one direction causes a specially-formed sliding nut to throw the screw out of gear; but rotation in the reverse direction allows the nut to come into gear again.

MECHANISM FOR MOVING FILMS OR WEBS INTERMITTENTLY.—AUGUST and LOUIS CHRONIK, Manhattan, New York city. This mechanism, for employment in connection with chronophotographic apparatus, comprises a drum-wheel having projecting elements and two actuating devices therefor, each having locking-faces and driving elements for engagement with the projecting elements of the drum-wheel. The projecting elements of the drum-wheel in the locked position are out of the path of travel of the driving elements of one actuating device and in the path of travel of the driving elements of the other actuating device. It is claimed that by means of this mechanism pictures can be exhibited or taken without danger of the film's slipping or not moving the desired distance.

LUMBER-MEASURING INSTRUMENT.—JOSEPH A. WHITE, JR., Warsaw, Ill. To provide a simple instrument by means of which the measurement of any board may be quickly taken without mental calculation, is the purpose of this invention. The novel features of the invention are found in an adding-device having a series of numbered tumblers operated by drawing the tape across the lumber to be measured. With five tumblers measurements may be recorded up to one hundred thousand feet; by varying the tumblers, the capacity of measurement may be correspondingly varied. By means of the device the total foot-measure in any number of boards of equal or unequal lengths may be ascertained.

WEIGHING-MACHINE. — SAMUEL P. MACKEY, Ridgefield, Wash. The inventor has devised a receptacle which, having been operatively connected with a liquid supply, will open the valve and allow the liquid to enter until the scale-beam is overbalanced, whereupon a portion of the device is turned, the receptacle drops, and the inlet valve closes. If so desired, a second or outlet valve may be opened in the receptacle, allowing the liquid to find an exit therefrom. The receptacle may be so placed upon a support that one of the machines can accommodate several different storage-reservoirs, and that the attachment between the machine and any one of the reservoirs may be quickly made.

Railway-Contrivances.

GRAIN-CAR DOOR.—ALBERT N. HOPKINS, Duluth, Minn., and FRANKLIN P. HOPKINS, Hyattsville, Md. Grain-car doors should be capable of being opened outward, and swung inward when the car is empty, and locked in closed position. To attain these ends, the inventor forms a recess in the outer face of the door and provides the door with locking and sealing plates at its opposite edges. An adjusting connection is seated in the recess. Rods are secured to the locking-plates and are threaded into the adjusting connection. Guides for the rods have base-plates lying on opposite sides of and forming bearings for the adjusting connection.

Miscellaneous Inventions.

DISPLAY-CARD. — BARNET COHN, Brooklyn, New York city. This card is designed to display such jewelry as finger-rings, screw ear-rings, pendent ear-rings, scarf-pins, and the like. While the various cards used are modified to suit the different articles for which they are intended, they all have the same characteristics; that is each has a main or front plate with a holding device and a strip movable relatively thereto.

SMOKE-CONSUMING FURNACE. — ANDERS B. RECK, Copenhagen, Denmark. The fuel-chamber of the furnace has its walls composed of superposed, separated bars surrounding a central space. A body surrounds the fuel chamber in proximity to the bars. The body has air inlet and outlet channels immediately adjacent to the bars so that the channels communicate with the central space of the fuel-chamber through the space between the bars.

MOTOR-VEHICLE. — GUSTAVE V. L. CHAUVEAU, Paris, France. The present invention has for its object improvements in automotive tricycles of a type intermediate between a velocipede and a full-sized road-carriage. These improvements relate more particularly to special arrangements of removable seats and parcel-carriers. The arrangement of seat devised it is said affords a passenger a comfortable position such as has never hitherto been obtained. For the removable front seat a box for carrying goods for tradesmen's use is employed, which box may be readily detached when no longer required.

FLAGPOLE. — EDWARD ROWE, Indiana, Pa. The pole is constructed of metal, in skeleton form, and is made in sections capable of being readily fitted together, enabling the pole to be transported conveniently from place to place and set up by the average workman. A pole of this type, 136 feet high and weighing 8,000 pounds, has been erected on the grounds of the Indiana Normal School.

HEARSE. — ABNER C. COX, Belleville, Kan. The hearse is provided with a tilting platform which can be adjusted up or down at both ends in order to keep the body at a true level in ascending and descending grades. The invention is also applicable to ambulances and similar vehicles.

RUNNING-GEAR. — GEORGE F. UEBEL, Harlan County, Neb. (P. O. address: Oxford, Furnas Co.) This running gear is especially applicable to agricultural separators and is designed to facilitate the movement of the vehicles and to assist in turning them by causing both axles to swing in the act of turning. To the bolsters, sills are rigidly attached. Two curved track-plates are attached to one of the bolsters and project at the front and rear. The track-plates have lugs engaging the bolster and blocks at their ends for connection with the sills. Antifriction-rollers are mounted on the axle beneath the track-plates and respectively engage the track-plates.

PASSENGER-REGISTER.—ORLANDO C. ALSPAUGH, Newton, Kan. This invention provides a device for registering automatically the number of miles and fractions of a mile during which a seat in a railway-car has been occupied, thus furnishing the mileage earnings of a train and enabling any shortage or errors to be ascertained. Each seat is provided with a registering-device so constructed that the weight of a passenger will set it in operation during the time the seat is occupied. The device can be adjusted to carry children without registering, and will prevent a passenger from occupying more than one seat.

ELASTIC TIRE AND RIM FOR WHEELS.—WILLIAM F. WILLIAMS, London, England. The wheel-rim is of channeled section and has flanges inwardly projecting from the side cheeks of the rim. An elastic tire formed of an endless outer cover of transversely-arched section provided with inwardly-projecting rigid flanges in short lengths incloses a connected series of juxtaposed transversely-extended springs bent to an arched form and provided with hooked ends which engage with the inwardly-projecting flange of the rim. The sides of the cover are held between the cheeks of the rim; and the inwardly-directed flanges of the cover are clamped by the springs against the inwardly-projecting flanges of the rim.

PLATFORM-TRUCK.—GEORGE K. DAVIS, Lewiston, Me. The present invention provides a platform-truck especially adapted for use in an orchard and for use by builders. The truck is so constructed that its platform may be lowered or raised and held firmly in either position, and that it may be conveniently moved around a tree or the like, to which it may be attached or used in the same manner as an ordinary truck. The truck may be held stationary even when it is not attached to an object.

ARCHITRAVE, ARCH, AND LINTEL.—EDWARD M. HACKETT, Manhattan, New York city. Blocks of terra-cotta or like material have been devised so constructed that when combined between iron beams or other supports they will have a dovetail connection to enable a straight structure to be erected between the beams or other supports. One side may serve as a floor and the opposite side as a ceiling, the blocks or members being so tied together as to impart to the straight or architrave structure all the strength of the arch.

DRILL.—LAFAYETTE DURKEE, Denver, Col. This drill is an improvement in "jump-drills," in which the reciprocating driving member has a spring connection with the drill-holder. In the present improvement, a novel means is employed for connecting the driving mechanism with the drill, so that the reciprocation of the drill in one direction is made more rapid than in the other direction. A compensating spring sustains the weight of the drill-holder.

BOOT-BLACKING CHAIR.—ANDREW C. HOLMES, Chicago, Ill., and LOUIS J. HOLMES, North Clarendon, Pa. The chair has a swinging seat beneath which is located a foot-rest connected with the seat to slide outward as the seat is raised. When the chair is occupied, the seat is raised, thus projecting the foot-rest forward and placing the device in position for use in blacking the shoes.

WAIST-BELT. — CHARLES MESSICK, Jr., Hackensack, N. J. This belt has a pocket adjacent to the buckle and adapted to receive that end of the belt which is passed through the buckle so that when the belt is in position upon the body the end which is passed through the buckle will not be visible, thus dispensing with the necessity of a loop and also preventing the free end of the belt from being carried out of engagement with the body-portion of the belt.

Designs.

BADGE.—WILLIAM J. CROWE, St. Catherines, Canada. The leading feature of the design consists of a badge having a shield forming the base, and an eagle holding a pan on the obverse of the shield.

WATCH-CHAIN AND NECKLACE.—MARCEL M. MIRABEAU, Manhattan, New York city. This design provides a combined watch-chain and necklace for ladies' wear. The device has the especial merit of enabling the wearer to adjust the necklace portion in any desired manner, the adjustment being most readily effected by the use of side-buttons attached to the necklace portion and sliding on the runs of the watch-chain.

PIN.—MARY J. SMITH, Manhattan, New York city. The leading feature of the present design is a foundation-plate in which there is an irregular opening and a tongue which extends over the face of the foundation-plate and across the opening.

WASHER.—JOHN J. TURNER, Manhattan, New York city. The washer is funnel-shaped at its upper and lower ends; and its upper end is formed with radiating spouts. The device is placed in a wash-boiler, and by its geyser-like action is designed to facilitate the cleansing of the clothes.

CAP. — MARK DAVIS, Manhattan, New York city. The cap has two vizors extending oppositely from a crown with a flat top and with sides bulging down over the vizors.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

DIE MODERNE CHEMIE. Eine Schilderung der chemischen Grossindustrie. Von Dr. Wilhelm Bersch. Vienna: A. Hartleben. 1899. Large 8vo. 1 Leiferung. Illustrirt. Price 20 cents.

Dr. Bersch has undertaken the task of describing all industries which employ processes based upon chemistry. The work is not technical in the true sense of the word; but appeals more to the general reader. The field covered is very broad, extending as it does over every chemical process employed in the arts and manufactures of our times.

LEXICON DER METALL-TECHNIK. Redigirt von Dr. Josef Bersch. Vienna: A. Hartleben. 1899. Large 8vo. 1 Leiferung. Price 20 cents.

From this first installment of Hartleben's metallurgical dictionary, it would seem that a long felt want in German technical literature is about to be filled. The modern ironmonger has neither the time nor the inclination to wade through a mass of technical books in order to find the information which he is seeking. He would, no doubt, prefer a reference book in which he could find trustworthy explanations of the problems he endeavors to solve. Such a work is this "Lexicon der Metall-Technik."

STEAM ENGINE INDICATOR AND ITS APPLIANCES. By William Houghtaling. Bridgeport, Conn.: The American Industrial Publishing Company. 1899. Pp. 307. 8vo. 157 illustrations. Price $2.

The volume before us is a comprehensive treatise for the use of constructing, directing and operating engineers, superintendents, master mechanics and students, describing in a clear and concise manner the practical application and use of the steam engine indicator. It is accompanied with many illustrations, rules, tables and examples for obtaining the best results in the economical operation of all classes of steam, gas and ammonia engines, together with original and correct information on the adjustment of valves, computing horse power, diagrams and extended instructions for attaching the indicator. The subject appears to have been treated in an admirable manner by a thoroughly practical man. The literature relating to indicators is already quite large, but there is no doubt that there is an ample field for usefulness for the present book.

CHARACTERS OF CRYSTALS. An Introduction to Physical Crystallography. By Alfred J. Moses. New York: D. Van Nostrand Company. 1899. Pp. 211. 8vo. Price $2 net.

A new book on crystallography has been needed for a long time, and Dr. Moses, the Professor of Mineralogy in Columbia University, is splendidly equipped for writing a book on the subject. He has certainly succeeded in elucidating many points which have always proved troublesome to students. In the present volume he has given a large number of diagrams which are either original or have been published only in German works on the subject. It is a book which we can unqualifiedly recommend.

A PRIMER OF CALCULUS. By E. Sherman Gould. New York: D. Van Nostrand Company. 1899. Pp. 122. 18mo. Plates. Price 50 cents.

This is a second edition, revised and enlarged, of a book which we reviewed a year ago. Calculus is apt to prove a great stumbling block to readers of scientific and engineering books and to students. With the aid of a book of this kind the labor of the student will be much simplified.

THE HISTORY AND ANTIQUITIES OF THE COLLEGIATE CHURCH OF SAINT SAVIOUR, SOUTHWARK, LONDON. By Rev. Canon Thompson, M.A., D.D. London. 1898. Pp. 78. Illustrations.

It is a mistake to believe that there are no lovers of London monumental buildings in America; they are, however, few in number, but they will appreciate the rare treat which has been prepared for them by Canon Thompson. The matter is interestingly presented, and the illustrations and plans are numerous and good. The whole is a valuable contribution to ecclesiology.

MANUAL OF ASSAYING GOLD, SILVER, LEAD AND COPPER. By Walter Lee Brown. Pp. 551. 12mo. Price $2.50.

It was only a short time ago that we reviewed Brown's "Assaying," and now its phenomenal sale has caused a new edition to be printed. We have already expressed our opinion of this book several times. We only desire to say that it is the most admirable book on the subject which has been written, and no one who desires a book on assaying should miss an opportunity of acquiring a copy.

NOTES ON DESCRIPTIVE GEOMETRY. By W. L. Ames. Terre Haute, Ind.: S. P. Burton. Pp. 90. 18mo. 95 illustrations. Price 50 cents.

It is evident to all who have taken note of the trend of practice in mechanical drawing in the best drafting offices that the use of the third quadrant in projecting will become universal. In the study of descriptive geometry, however, with few exceptions, the first angle projection is taught. The author of the little booklet before us has for some time used the third angle in teaching descriptive geometry. The methods given appear to be very satisfactory in practice.

HAY FEVER AND ITS SUCCESSFUL TREATMENT. By W. C. Hollopeter, A.M., M.B. Philadelphia: P. Blakiston, Son & Company. 1899. Pp. 151. 12mo. Price $1.

About a year ago we had the pleasure of reviewing the first edition of this book, and now we are glad to know that a second revised and enlarged edition is ready for the public. Hay fever sufferers are so numerous that we should not be surprised if a third edition would be called for in a short time. The ordinary practitioner is often wofully ignorant of this very peculiar disease, and we think that many patients would be pleased to read up the subject themselves, although of course we do not approve of self-doctoring.

DAS LÄNDLICHE WOHNHAUS. Studie über praktische Anlage von kleinen Landhäusern und Cottages in Verbindung mit Gärten. Von Alfred Reinhold. Vienna: A. Hartleben. 1899. Pp. vii, 78. Large octavo, with 76 illustrations. Price, paper, $1.

The little book which lies before us is chiefly intended to assist architects in the erection of cheap country homes. The author has taken as his motto the words of Bacon, "Houses are built to live in and not to look on," and with this as his guiding principle, offers us a work which is valuable for the ideas which it presents, and for the practical advice given to builders of cottages.

TASCHENBUCH DER PRAKTISCHEN PHOTOGRAPHIE. Von Dr. E. Vogel. Berlin: Gustav Schmidt. 1899. Pp. vi, 308. 12mo. Illustrated. Price, cloth, $1.

The late Dr. Vogel's work in photography requires no extended praise here. It has been so fully treated in the photographic and scientific press that another review is superfluous. The little "Taschenbuch" is one of the most popular of Vogel's photographic books; and that it has now passed through a sixth edition is no more than its due.

OBSERVATIONS SUR LES FRELONS. Par Charles Janet. Extrait des Comptes rendus hebdomadaires des séances de l'Academie des Sciences. Paris. 1895.

ETUDES SUR LES FOURMIS, LES GUÊPES ET LES ABEILLES. Note 14. Rapports des Animaux Myrmécophiles avec les Fourmis. Limoges. 1897.

ETUDES SUR LES FOURMIS, LES GUÊPES, ET LES ABEILLES. Note 15. Appareils pour l'Observation des Fourmis et des Animaux Myrmécophiles. Par Charles Janet. Paris. 1897. Au Siège de la Société Zoölogique de France.

SUR LES MUSCLES DES FOURMIS, DES GUÊPES ET DES ABEILLES. Par Charles Janet. Extrait des Comptes rendus hebdomadaires des séances de l'Académie des Sciences. Paris. 1895.

SUR LA VESPA CRABRO L. PONTE, CONSERVATION DE LA CHALEUR DANS LE NID. Par Charles Janet. Extrait des Comptes rendus hebdom. des séances de l'Académie des Sciences. Paris. 1894.

SUR LES NÉMATODES DES GLANDES PHARYNGIENNES DES FOURMIS (PELODERA, SP.) Par Charles Janet. Extrait des Comptes rendus hebdomadaires des séances de l'Académie des Sciences. Paris. 1893.

The Street Railway Journal of New York in addition to the regular monthly issue will hereafter publish a "weekly news edition" containing in digested form the current electric railway news of the world. Progress in electric traction is so rapid that even an ably conducted paper like the journal cannot always be on time with news, so their enterprise in starting a weekly is to be commended.

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(7686) J. A. M. says: Will you give me a formula for the prevention of mildewing of cloth exposed to the weather? A. Dissolve 1 pound zinc sulphate in 40 gallons water, and then add 1 pound sal soda. When dissolved, 2 ounces tartaric acid are added. This holds the partially separated zinc carbonate without neutralizing the excess of alkali used. The cloth should be soaked in this solution for twenty-four hours and then dried without wringing.

(7687) E. C. L. M. asks: 1. What are the phenomena of the so-called "cloud burst"? A. A cloud burst is a thunder shower with so excessive a fall of rain that it seems as if the cloud itself was falling to the earth. They are thought to be due to the overturning of a mass of air which is in unstable equilibrium. They are very limited in extent, and last for a short time only. Little streams are swollen to rivers, and rush down the valleys, carrying soil, trees and even large bowlders with them and leaving desolation behind them in their track. The term originated in the Western United States, but its use has extended to the East, and is now used to describe any storm of more than usual severity. 2. Why does one perspire more when sleeping in a hot room (as we have here) than when sitting awake? A. We cannot answer this inquiry with any positiveness; but would suggest as a possible cause of the difference that when awake we are continually in motion, and therefore changing the air which is in contact with the surface of the body. The effect of this is like fanning or the use of the punka. But when asleep, the air lies motionless upon us, and is soon saturated with moisture, thus adding to our discomfort.

(7688) I. A. McC. writes: I would be glad if you would answer through Notes and Queries the question of what the pressure is in the modern gas engine at the instant of explosion under the most favorable circumstances. I asked the question of a manufacturer of gas engines who is rapidly coming into prominence in this portion of the country, and his answer was that under the most favorable circumstances the pressure was very close to 300 pounds per square inch. This is much more than I had ever heard it stated before, some parties giving it as low as 60 pounds. I have read no authorities on this question, but consider that 300 is rather extravagant and do not know whether the smaller figure is as extravagant as the other or not, but would think it a little too small. Another question I would like to understand is: What is the expansion of 74 degree gasoline measured in volumes when converted into gas at a pressure of one ounce per square inch? Also what is considered the best proportion of such gas and air for the most effective explosion? A. The explosive force in gas and gasoline engines varies with the charge compression. This may be from 30 to 80 pounds according to the volume of the combustion chamber or clearance adopted by the builder in the design of the engine. A low compression charge may give an explosive pressure of from 80 to 125 pounds per square inch; while a high compressive charge may raise the explosive pressure to from 150 to 250 pounds and possibly 300 pounds. Thousands of explosive motors are running at from 150 to 175 pounds maximum pressure. The vapor of gasoline is equal to 130 volumes of the liquid without admixture of air. The vapor and air mixture for highest explosive effect is one of vapor to six of air. The mixture continues explosive up to one part of vapor to ten parts air with economical effect.

TO INVENTORS.

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Cleaner. See Bicycle chain cleaner. Dish cleaner. Window cleaner.
Clock system, electric, Hope-Jones & Bowell ... 628,325
Cloth pressing machine, D. Gessner ... 628,242
Clothes drier, J. J. Pelton ... 628,211
Clothes pounder, C. W. Cross ... 628,076
Clutch, E. S. Clarke ... 628,390
Clutch, M. Kane ... 628,249
Clutch and handle, combined rope, S. C. Houghton ... 628,224
Clutch, friction, S. Jackson ... 628,328
Coffee roaster, D. B. Fraser ... 627,993
Coin controlled apparatus, R. Wagner ... 628,171
Combination chair, J. Sheridan ... 628,166
Compressing powdered substances, apparatus for, P. E. M. Jamain ... 628,225
Confessional register, P. J. O'Connor ... 628,229
Conveyer, endless, T. L. Marvel ... 628,274
Conveyer, suction or injector, J. Sibley ... 628,187
Corset, M. Tucek ... 628,372
Corset closure, Klemschmidt & Kreuder ... 628,335
Counting apparatus, R. Burk ... 628,975
Coupling. See Car coupling. Shaft coupling. Stovepipe coupling. Tap coupling. Thill coupling.
Cover, F. B. Read ... 628,354
Covering machine, L. Vining ... 628,049
Crate, knockdown, A. Donnelly ... 628,304
Crib or cradle, folding, S. E. & H. Oakes ... 628,350
Cross tie, metallic, E. U. Stewart ... 628,215
Cultivator, D. C. Bushnell ... 627,976
Cultivator, two row wheel, J. H. Dempster ... 627,986
Currents, controlling high tension, H. G. O'Neill ... 628,026
Currents, method of and apparatus for varying the number of phases of polyphase, H. A. Rowland ... 628,358
Curtain rod bracket, F. Harris ... 628,199
Cut out plug, A. Johnston ... 628,180
Cutter. See Straw or feed cutter.
Cutting tool, H. S. Newcomb ... 628,280
Cycle gear, T. H. Williams ... 628,135
Cyclometer, A. A. Leuchter ... 628,340
Dental chair, adjustable, G. Holtz ... 628,244
Desk, E. M. Mosher ... 628,346
Diamonds and their mountings, gage for, S. Goldner ... 628,310
Dish cleaner, W. C. Williams ... 628,292
Dish washer, M. J. Mendenhall ... 628,409
Door hanger, C. A. Ensign ... 627,991
Door holding device, C. W. Sponsel ... 628,366
Door storm strip, C. Mitsch ... 628,278
Dough mixer, C. Cornelius ... 628,073
Dough mixer, W. & P. Kryszewski ... 628,337
Drain, cellar, G. O. Miller ... 628,207
Drawer centering device, J. M. Hoffmire ... 628,322
Drier. See Clothes drier. Fruit drier.
Drill, P. C. Forrester ... 628,404
Dye and making same, blue black wool, C. Oelschlaegel ... 628,025
Dye and making same, green trisazo, C. Simon ... 628,233
Dye, green acid, A. Herrmann ... 628,243
Ear drum, G. P. Way ... 628,051
Electric furnace, F. P. Van Denbergh ... 628,373
Electric machine, dynamo, Hutin & Leblanc ... 628,245
Electric meter, T. Duncan ... 628,240
Electric motor attachment, C. R. Meston ... 628,014
Electrode for therapeutic purposes, vacuum, H. G. O'Neill ... 628,352
Electrotherapeutic apparatus, H. G. O'Neill ... 628,351
Elevator safety device, U. S. Alz ... 628,260
Elevator safety device, J. D. Griffen ... 628,090
End gate, wagon, H. Wittich ... 628,425
Engine, G. De Camp ... 628,397
Engine, De Camp & Roth ... 628,398
Engine lubricating device, W. M. Musgrave ... 628,279
Envelop, W. Wolfe ... 628,152
Eyelet, D. C. See ... 628,165
Eyeleting machine, P. R. Glass ... 628,309
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Eyeleting machine gage, Whittemore & Glass ... 628,423
Fare register, S. C. Houghton ... 628,223
Fastener for envelops, etc., metal, H. C. Holcombe et al ... 628,324
Fastener stud member, detachable, E. Pringle ... 628,095
Fastener stud member, separable, G. E. Adams ... 627,961
Fastening device, A. Leblanc ... 628,203
Faucet, E. N. West ... 628,258
Feed water heater, J. W. Casey ... 627,980
Feed water heater, H. A. Millar ... 628,344
Fence, A. E. Lycan ... 628,102
Fence, L. A. Short ... 628,167
Fence machine, wire, J. Bennington ... 627,969
Fence making machine, Pendergast & Whidden ... 628,253
Fence post, O. E. Newquist ... 628,208
Fertilizer distributer, E. J. Corser ... 627,983
Fertilizer distributer, L. V. Labelle ... 628,100
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Filter press, J. Williamson ... 628,057
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Foot rest and child's seat, combined, J. R. John ... 628,331
Footwarmer, A. & W. C. Meyer ... 628,182
Fountain. See Watering fountain.
Fruit drier, E. F. Schneider ... 628,212
Furnace, P. O. Krottnaurer ... 628,336
Furnace air feeding apparatus, J. S. Newlin ... 628,349
Furnace lining, metallurgical, B. Talbot ... 628,288
Gage. See eyeleting machine gage.
Galvanic battery, J. von der Poppenburg ... 628,116
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Gas burner, J. F. Barker ... 628,063 to 628,065
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Gas engine, W. S. Sharpneck ... 628,122 to 628,125
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Gas generator, acetylene, R. F. Dull ... 627,989
Gas generator, acetylene, S. Hanford ... 628,198
Gas generator, acetylene, H. Keller ... 628,200
Gasolene or gas engine, J. A. Harp ... 628,317
Gate. See End gate. Railway gate.
Gate, S. W. Martin ... 628,013
Gear, driving, J. K. Starley ... 628,169
Gearing, W. W. Kenfield ... 628,407
Generator. See Gas generator.
Glass articles, making, M. J. Owens ... 628,027
Glass articles, perforating, E. A. Parker ... 628,030
Glass bottles, machine for manufacturing, L. Grote ... 628,313
Glass, making rough plate, P. Semmer ... 628,120
Glass pressing apparatus, G. E. Cleveland ... 628,157
Glassware, decorating, H. Thuemler ... 628,131
Glove, D. H. Murphy ... 628,017
Golf practicing apparatus, J. G. Warren ... 628,236
Gong, alarm, E. W. Vanduzen ... 628,133
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Gun, cane, E. H. Ericson ... 628,142
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Harrow, disk, Packham & Oates ... 628,028
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Heater. See Feed water heater. Water heater.
Heel, J. W. Cross ... 627,984
Heel protector, shoe, E. Slauson ... 628,188
Hinge joint for flat articles, G. Cohn ... 628,239
Hinged case, A. L. Mariner ... 628,103
Hoe and cultivator, horse, F. Bateman ... 627,965
Holdback attachment, vehicle, H. H. Brown ... 628,301
Hook, See Singletree hook.
Hook and eye, E. W. Groeschel ... 628,143
Horseshoe, nailless, H. Broers ... 627,974
Hose gate, E. S. Clarke ... 628,391
Hose safety device, hydraulic, J. Muskett ... 628,018
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Ice creeper, detachable, Feather & Saxton ... 628,263
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Indicating and registering distances, etc., apparatus for, J. Ridge et al ... 628,037
Indicator. See Liquid level indicator.
Ink well cover, B. G. Merrill ... 628,107
Insole, slipper, A. Lennon ... 628,339
Insulators for carrying electric line wires, fixing of, W. Menzel ... 628,343
Iodin compound and making same, A. Classen ... 627,981
Iodin derivatives of aromatic amins and making same, A. Classen ... 627,982
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Ironing table, A. Josephs ... 628,332
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Lamp, hydrocarbon incandescent, W. S. Proskey ... 628,415
Lantern holder and foot warmer, W. M. Wilmarth ... 628,377
Last, W. B. Arnold ... 628,238
Lasting machine, Keats & Clark ... 628,200
Lemon squeezer, G. E. Savage ... 628,254
Letter press, Hardy & Maple ... 628,266
Level and plumb, combined, Keyser & Roche ... 628,334
Liquid level indicator, H. Rasmussen ... 628,353
Liquid meter, Gray & Farrar ... 628,312
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Loom, W. J. Lutton ... 628,206
Loom, E. P. Mason ... 628,226
Loom, J. Northrop ... 628,228
Loom, circular, J. & C. Herold ... 628,093
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Loom shedding mechanism, S. Arienta ... 628,154
Lubricating plug, McAlexander & Thomas ... 628,019
Lubricator. See Axle lubricator.
Machinery, electrical slow starting device for, I. Stone ... 628,190
Magnetic separator, A. Dings ... 628,078
Mashing apparatus, O. Selg ... 628,232
Mattress stuffing machine, R. R. Thompson ... 628,047
Measuring machine, cloth, J. H. Vanderburgh ... 628,374
Mechanical elements, device for securing, H. Zorn ... 628,060
Mechanical movement, R. L. Crossman ... 628,220
Mercur-ammonium compound and making same, C. F. M. Schaerges ... 628,417
Mercury soluble in water and manufacturing same, product of, A. Lottermoser ... 628,270
Metal tube, compound, G. H. Everson ... 627,992
Metal working machine counter mechanism, N. Sperber ... 628,043
Metals by electricity, heating, E. M. Bentley ... 628,429
Metals, ornamenting, P. C. McIlhiney ... 628,348
Meter. See Electric meter. Liquid meter.
Milking apparatus, W. H. Lawrence ... 628,338
Mill. See Rotary mill. Windmill.
Mine shafts, etc., means for raising water from, R. E. Browne ... 628,219
Mineral lode tracer, Heyland & Gray ... 628,321
Mining and dredging ejector, W. Muir (reissue) ... 11,755
Mining machine, coal, C. M. Johnson ... 628,007
Mixer. See Dough mixer.
Mould and weight gage, A. C. Gillette ... 628,405
Mould for composition rollers, E. Stough ... 628,367
Moulding, picture, G. F. Drew ... 628,140
Money holder and changer, G. T. Farnell ... 628,401
Monorailway system, L. Beecher ... 628,174

(Continued on page 46)

Advertisements.

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Inside Page, each insertion, - 75 cents a line
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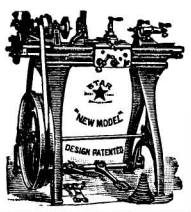

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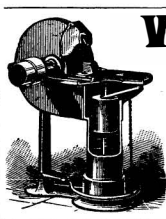
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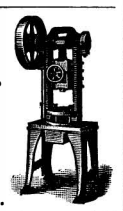

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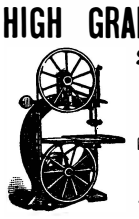
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Your Correspondence is Solicited.
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Christiana, Pa., U. S. A.
Engineers, Founders and Machinists.
Manufacturers of Turbine Water Wheels, adapted to all duties.

Power Transmitting Machinery, Gearing, Rope Wheels, Friction Clutches, Shafting, Pulleys, Hangers, etc.
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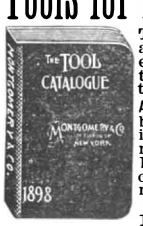

Tools that are common and Tools that are rare, costly and cheap Tools, and every other kind of Tool used in any trade you will find described and illustrated in MONTGOMERY'S TOOL CATALOGUE FOR 1898. A handsome book containing 510 pages and copious index. Pocket size 6¼ x 4¼ inches, with rounded edges and stitched covers. Every workshop and factory in the country should have one. Sent by mail for 25 cents by
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WE SUPPLY WHAT YOU WANT, ANY THICKNESS OF METAL AND SIZE & SHAPE OF HOLE.
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SMITH & WESSON,
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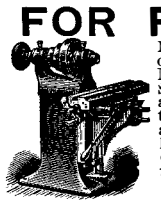
Catalogue for a stamp.

FOR FINE WORK



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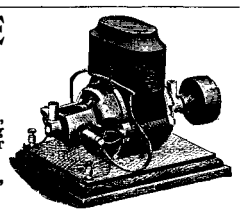

Complete with spark coil, $11.50. The **Best Thing** on the market. Send for catalogue.

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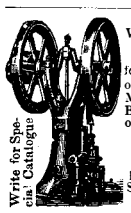

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This beats Wind, Steam, or Horse Power. We offer the **WEBSTER** 2½ actual horsepower

GAS ENGINE

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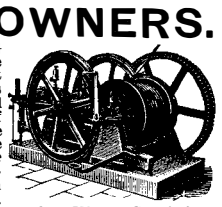
TO MINE OWNERS.



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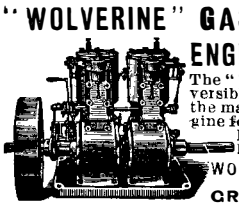
"WOLVERINE" GAS AND GASOLINE ENGINES, STATIONARY and MARINE.



The "Wolverine" is the only reversible Marine Gas Engine on the market. It is the lightest engine for its power. Requires no licensed engineer Absolutely safe. Manufact'd by

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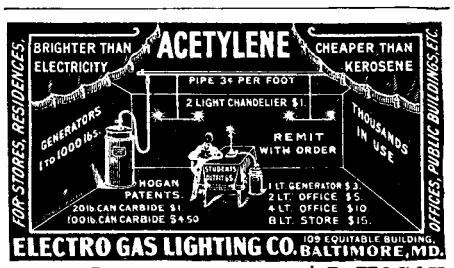
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PIPE 3¢ PER FOOT
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FOR STORES, RESIDENCES, OFFICES, PUBLIC BUILDINGS, ETC.
ELECTRO GAS LIGHTING CO. 109 EQUITABLE BUILDING, BALTIMORE, MD.

New Light. Address all letters to **G. L. HOGAN, Manager.**

Automobiles

The SCIENTIFIC AMERICAN for May 13, 1899, is devoted mainly to illustrations and detailed descriptions of various types of horseless vehicles, This issue also contains an article on the mechanics of the bicycle and detailed drawings of an automobile tricycle. Price 10 cents.

The following copies of the SCIENTIFIC AMERICAN SUPPLEMENT give many details, of Automobiles of different types, with many illustrations of the vehicles, motors, boilers, etc. The series make a very valuable treatise on the subject. The numbers are: 732, 979, 993, 1053, 1054, 1055, 1056, 1057, 1058, 1059, 1075, 1078, 1080, 1082, 1083, 1099, 1100, 1113, 1122, 1178, 1195, 1199, 1206, 1210. Price 10 cents each. by mail. For sale by all newsdealers or address

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Musical instrument, mechanical, F. Gronau	627,999
Necktie fastener, J. Rommel	628,118
Nipple wrench, H. J. O'Leary	628,414
Nose screen, S. M. McHatton	628,111
Nozzle, variable exhaust, W. E. Symons	628,369
Nut and bolt lock, A. Barr	628,297
Oil can, A. Miller	628,435
Oils or fats, apparatus for treating, C. G. Hepburn	628,092
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Ore concentrator, Mather & Snyder	628,105
Oven, H. Werner	628,052
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Package, storage, M. Falk	628,159
Paper box machine, C. R. Bannihr	628,062
Paper feeding machine, W. G. Trevette	628,132
Paper folding machine, H. F. Bechman	628,066
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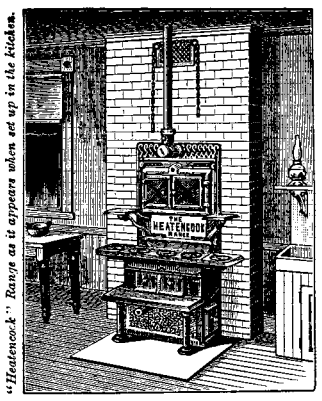

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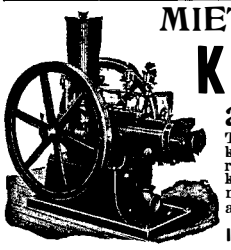

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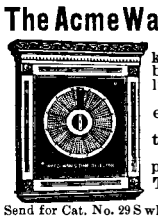

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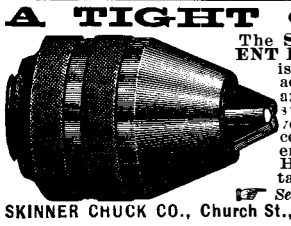

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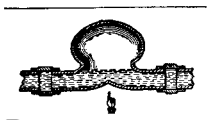

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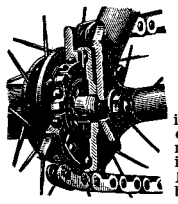

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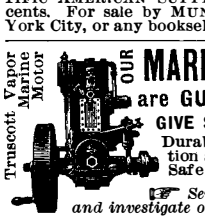

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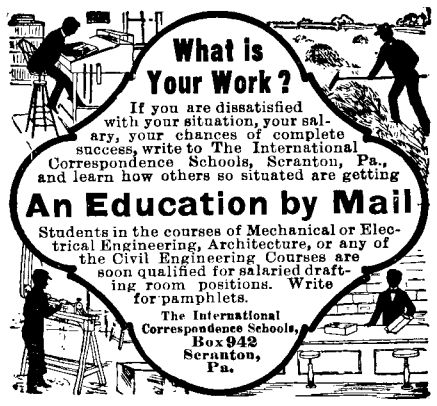

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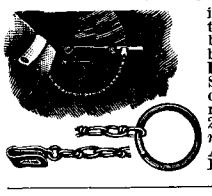

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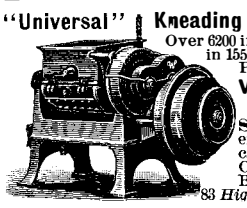

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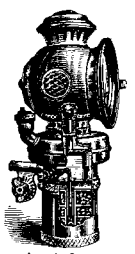

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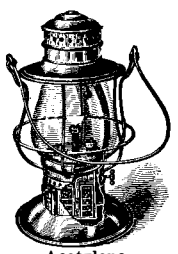

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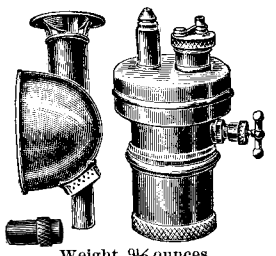

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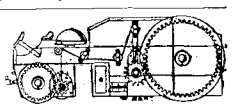

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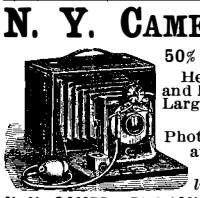

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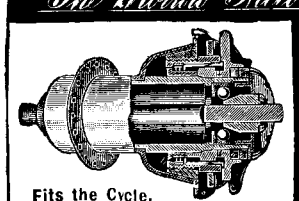

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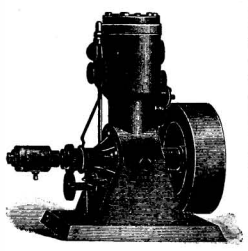

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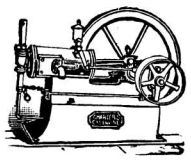

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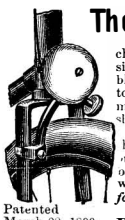

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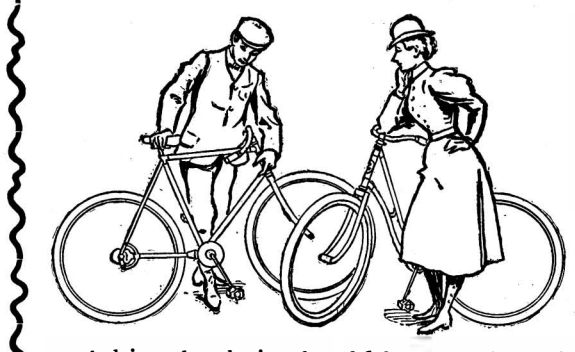

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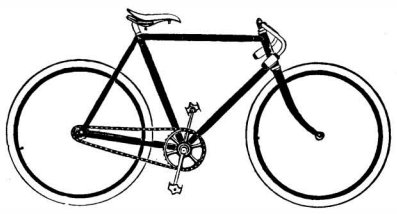

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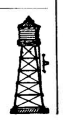

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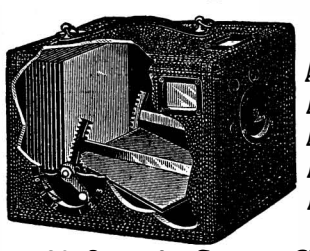

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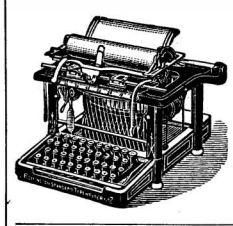

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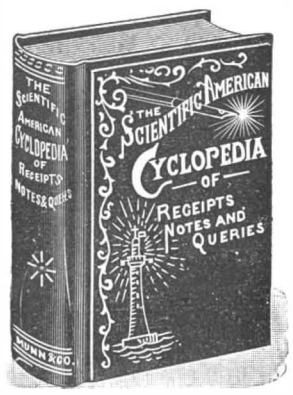

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